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A Benefits Analysis

Energy and Resource Consultants, Inc.
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OXIDANTS AND ASTHMATICS IN LOS ANGELES: A BENEFITS ANALYSIS

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ABSTRACT

This study examines changes in behavior, expenditures and willingness to pay as related to changes in asthma severity. It is based upon information for a panel of 82 asthmatics in Glendora, California, gathered in the fall of 1983. The panel of asthmatics represents individuals of a population expected to be sensitive to ambient oxidant levels.

The study specifically focuses upon measuring mitigating behavior and its effect upon epidemiology and economic studies, and upon the importance in morbidity valuation studies of using a willingness to pay (WTP) benefit measure rather than a cost of illness (COI) measure based only upon work loss and medical expenditures. Most of the detailed information was collected in two survey instruments: a diary completed daily for one month, and a general background and willingness to pay questionnaire.

The daily diary addressed the respondents' perceptions about factors that might affect their asthma, expectations about their asthma condition on that day, how their asthma actually was and their schedule. Economic theory assumes that if individuals were aware of factors that aggravate illness and were able to alter behavior to reduce that aggravation, they might take such mitigating action. If such behavior actually occurs, then epidemiological studies relating illness to that causal factor would be biased toward zero relative to what would occur in the absence of this behavior. Economic studies that attach COI measures to the results of these epidemiology studies would be biased toward zero by ignoring the costs of the mitigating behavior. Therefore, the objectives of the daily diary were to determine whether perceptions about air pollution were accurate, whether these perceptions altered expectations about whether a bad asthma day, as defined by the respondent using a symptoms rating scale, would occur and whether respondents altered their daily schedule on bad air pollution days.

The general background questionnaire addressed how well COI measures estimate the more appropriate WTP measures of value for changes in illness. Detailed estimates of all medical costs were obtained as well as a total WTP measure using a contingent valuation (CV) survey approach. Actual medical costs estimates, ranking of effects and the total WTP measure were used to infer WTP measures for damages of asthma related to work loss, medical costs, activities, discomfort and desired residential choice. Other supporting information about the effect of asthma on income, leisure, chores, and school was also obtained.

The principal finding of the diary is that a significant percentage of asthmatics have accurate perceptions about ambient air pollution conditions and expect their asthma to be aggravated when air pollution is high. When they expect their asthma to be aggravated by air pollution they are more likely to change their daily schedule in ways that can be expected to reduce pollution exposure and/or reduce asthma symptoms. These changes are in terms of fewer chores and less work and substitution from active leisure to inactive leisure or simply resting, sleeping or doing nothing at all. Since these substitutions lower exposure to ambient pollutants, they may reduce symptoms. In turn, this may bias estimated epidemiological relationships between pollutants and asthma severity toward zero.

The principal findings of the general questionnaire are that WTP measures for reductions in asthma severity are likely to be at least 1.6 to 2.3 times COI measures from the perspective of the affected individual, and at least 1.3 to 2.0 from the perspective of society as a whole. The best estimate of the sample mean willingness to pay for a 50 percent reduction in bad asthma days was $401. The comparable estimate of annual variable medical costs was $345, with one half paid by the household. The value of a reduction in one bad asthma day ranges from $4 to $84 depending upon asthma severity, with a mean of $21.

The analysis suggests that for a 50 percent reduction in bad asthma days, expected changes in discomfort and activity effects are both valued more highly than the expected changes in medical expenditures. Expected changes in work loss are valued approximately the same as expected changes in medical costs. Very small values were calculated for changes in the ability to live where one desires. Other important findings were that the empirical estimation of COI measures may often substantially understate the actual COI and that reductions in non-work restricted activity days appear to have substantial value. Methodological findings regarding the use of CV methods and estimating values for changes in health are also reported.

While the findings of this report have important implications, caution is advised in attempting to transfer the results to similar problems. The results are for a set of individuals with one illness living in one region, are based upon smaller than desired sample sizes, at times are based upon preliminary statistical analyses, and have not been replicated for similar morbidity impacts.

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March, 1985

OXIDANTS AND ASTHMATICS IN LOS ANGELES: A BENFITS ANALYSIS

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1.0 INTRODUCTION

Overview

This study estimates economic measures of changes in well-being related to changes in asthma severity. Ultimately this research may be combined with ongoing work at the UCLA Schools of Medicine and Public Health relating asthma severity to ambient oxidant concentrations to provide benefit estimates of oxidant control for asthmatics, a group of individuals considered to be sensitive to oxidants.

The study is based upon interviews with a panel of 82 asthmatics in Glendora, California, in the fall of 1983. It was conducted in cooperation with the U.S. EPA, the California Air Resources Board (CARB) and the UCLA researchers, who were also funded by CARB. The economic analysis focuses upon providing estimates of conceptually correct willingness to pay (WTP) benefits measures for changes in asthma severity, examining the potential effect of mitigating behavior on epidemiological estimates of the relationship between oxidants and asthma symptoms, and comparing WTP measures to the cost of illness measures that are most frequently used to value changes in adverse health symptoms. While the analysis specifically pertains to effects on asthma from changes in air pollution, many of the methodological findings are likely to be equally valid for other health impacts from other changes in environmental quality or changes in risks that are faced in everyday life.

Motivation for Estimating Economic Measures of Value for Reducing Health Effects from Changes in Environmental Quality

The analysis in this report specifically applies to health impacts from air pollutants. The Clean Air Act, as amended in 1977 (CAA77), established that ambient air quality standards should be set to protect all individuals' health. Regulations subsequently implemented have established primary standards for "criteria" pollutants to provide a margin of safety to protect the health of sensitive population groups by attempting to first establish exposure thresholds for these individuals. The scientific evidence, however, indicates that for many pollutants there may not be a threshold below which no individual's health is ever affected. As a result there may be some control levels where the marginal costs of control far exceed the marginal benefits to health, even though some individuals may still be affected.

According to the CAA77, costs and benefits of air pollution control are not required to be considered when primary standards are set to protect public health. Nevertheless, it seems clear that policy analysis has begun considering economic consequences more and more frequently. This is evidenced by the recent regulatory impact analyses, conducted in response to Executive Order 12291, for proposed changes in federal ambient air quality standards. These have been done for carbon monoxide, particulates and sulfur dioxide and are currently underway for ozone. Each of these analyses has paid considerable attention to economic efficiency arguments and to the costs and benefits of control using cost-effectiveness, benefit-cost, or risk assessment approaches. Benefits have been quantified in terms of exposures or dollars.

In analysis of air pollution control policies and regulations, economic analyses may help to determine an economically efficient threshold in cases where no physical effects threshold can be identified, help to identify the cost implications of alternative margins of safety, and help assess the economic costs and benefits associated with different strategies and time schedules for compliance with the selected standards.

The language in many of the laws to control pollution in other media does not mention the CAA77 requirement that standards to be set to protect against any potential adverse health effects. In these instances economic analyses provide one rationale for setting standards, strategies, and compliance schedules. The methods and findings reported herein are in many ways equally applicable to benefit analyses of other environmental health and safety issues.

Economic Approaches for Valuing Changes in Health and What This Study Adds

Economic studies of benefits (or damages) related to changes in health from changes in environmental conditions have tended to use a two step damage function procedure. First, epidemiology approaches and results are used to estimate changes in variables related to health status as environmental quality changes. These variables may include incidences of specific health effects, or other measures such as time taken off from work. Next, values are assigned to changes in work loss and medical expenditures related to the change in health status, and referred to as the "Costs of Illness" (COI). This estimation approach tends to understate the value of health impacts from air pollution for at least two reasons:

- It uses epidemiology estimates of health impacts. If individuals perceive "bad" air pollution days or locations and undertake expenditures and behavioral adjustments to avoid or mitigate exposure on these days, or at these locations, then epidemiological relationships between air pollution and health impacts will be biased toward zero. Further, the epidemiological relationships may estimate a threshold at which statistically significant effects are observed that is higher than the true threshold. Economic estimates will also be understated by not having captured the value of the averting behavior and expenditures.

- COI measures understate the value of health damages that individuals experience. For example, if an individual becomes more ill (or breaks a leg) then any discomfort and subsequent changes in activities he undertakes may be valued in addition to the work loss and medical costs incurred. To date, no one has quantified satisfactorily the importance of the discomfort and reduced activity effects associated with changes in illness.

This study was designed to test the existence and magnitude of the two above mentioned biases in health effect studies. The study also provides information that is timely for policy analysis of alternative oxidant standards. Unlike many other economic analyses, the study performs a benefits analysis for a sensitive population, the health of which the CAA77 standards are to be set to protect, and focuses upon morbidity effects rather than mortality effects. The valuation of morbidity effects has received little attention even though the majority of air pollution health impacts are of this type. The study provides both detailed COI and WTP measures for changes in asthma severity and examines the extent of mitigating behavior.

Organization of the Report

Epidemiological research examining health impacts of oxidants, specifically for asthmatics, and economic approaches used to value changes in health status are reviewed in Chapter 2. Chapter 2 also provides an economic model of value for changes in well-being from changes in health status. These reviews and the model were used to help focus the questionnaire design and analysis. Two questionnaires were developed. A daily diary examining daily perceptions and behavior was used to examine the effect of mitigating behavior on epidemiological results. A general questionnaire was administered to gather information about the effects of asthma on medical expenditures, employment, activities, chores and residential location and to obtain WTP estimates for changes in asthma severity. The questionnaires and survey procedures are reviewed in Chapter 3. Chapter 4 presents the statistical analysis of the questionnaire data. Chapter 5 provides conclusions and recommendations for future research with this data set, for related efforts, and for the design of questionnaires used to value changes in health.

While the findings of this report have important implications, caution is advised in attempting to transfer the results to similar problems. The results are for a set of individuals with one illness living in one region, are based upon smaller than desired sample sizes, at times are based upon preliminary statistical analysis and have not been replicated for similar morbidity impacts.

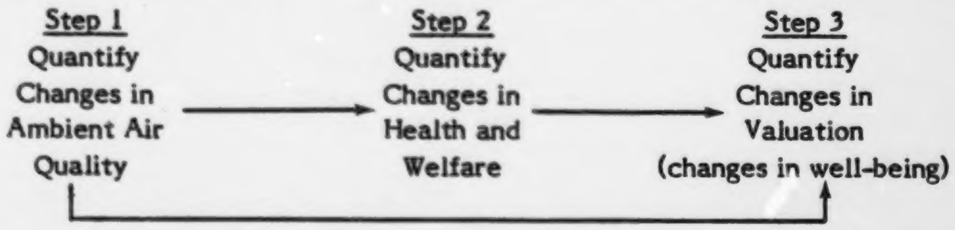
2.0 MEASURING AND VALUING THE HEALTH EFFECTS OF OXIDANTS

This chapter discusses methods, models and empirical results related to measuring and valuing health effects of oxidants, particularly for asthmatics. Several implications are drawn that focus the analysis. Empirical evidence suggests that asthmatics are sensitive to oxidants. Economic theory suggests that epidemological estimates of health damages from air pollution will be skewed toward zero due to the existence of defensive behavior. Economic theory also suggests that cost of illness (COI) estimates based upon medical costs and work loss for health incidents measured by epidemiological studies will understate willingness to pay (WTP) to reduce health impacts. This is because COI estimates miss the value of defensive behavior taken to reduce adverse health incidents and ignore the discomfort and change in lifestyle incurred as a result of adverse health incidents.

Estimating the benefits or damages to health of changes in air pollution requires an understanding of how changes in pollution emissions affect atmospheric conditions and thereby affect people's health and welfare, and how these effects are valued. These links are illustrated in Figure 2-1. Benefits analyses for changes in ambient air quality are of two general types: 1) damage function approaches that quantify the damage associated with different ambient air pollution levels (Step 2) and then estimate the value of preventing this damage (Step 3), and 2) direct valuation approaches that attempt to estimate directly the value of changes in ambient air quality (Step 1 to Step 3, skipping Step 2).

Figure 2-1

Steps in Measuring Benefits for Changes in Air Pollution


Step 1
Quantify Changes in Ambient Air Quality
Step 2
Quantify Changes in Health and Welfare
Step 3
Quantify Changes in Valuation (changes in well-being)

Direct valuation approaches presume that each individual judges for himself the impacts of changes in ambient air quality and then acts in accordance with the value he places on preventing these impacts. Data concerning his behavior and/or choices with regard to different levels of air quality, such as his choice of a residential location, then reveal his valuation.

The benefits analysis approach used in this study is of the damage function variety. The physical damages to health are to be determined by researchers at UCLA, although one could also use evidence from past studies reviewed below. The value of preventing these damages is the primary focus of this report. This approach has the advantage of not requiring that individuals generally be aware of air pollution as the source of adverse health impacts they may experience. This is especially important when studying health effects because there are so many confounding influences on an individual's health that in many cases the cause of any particular illness is very difficult to pinpoint. Air pollution may be just one of many aggravating factors. As long as individuals do not value differently the same health impact caused by different sources, the efforts to quantify and value air pollution health impacts can proceed as two independent tasks in the damage function approach. However, any bias or omissions in the estimates of health impacts may bias the resultant economic valuations.

The general nature of the health impacts from changes in oxidants (Step 2) and issues in determining the magnitude of these health impacts are briefly reviewed in Section 2.1. Section 2.2 discusses economic concepts and previous economic studies on the valuation of reductions in morbidity from air pollution control (Step 3) and describes how this study's approach is designed to add to the understanding of how to value changes in morbidity. Section 2.3 presents an economic model that formalizes the economic concepts of the individual's behavior with regard to health and helps focus the empirical analysis conducted in this study.

2.1 STUDIES ON THE HEALTH EFFECTS OF OXIDANTS

Three basic kinds of studies provide the most credible evidence concerning the health effects of oxidants: animal toxicology studies, clinical studies and epidemiological studies. Animal toxicological studies look at the effects of animal exposures to oxidants in a controlled laboratory setting. This can provide useful information about the potential biological and chemical mechanisms by which oxidants can affect human health, but the quantitative results cannot be directly transferred to humans. In clinical studies, human subjects are exposed to low levels of oxidants in a controlled laboratory setting and their physical responses are monitored. These kinds of studies can provide useful information about the effects of short term exposures to low levels of oxidants, but they are not able to capture the effects of long term exposures, and are limited in the range of oxidant levels that can be used.

Epidemiological studies, which look at the association between oxidant exposures and some measure of health across human populations, have been and are likely to continue to be the most widely used method to examine human health impacts from air pollution. These kinds of studies potentially provide relevant policy information because they look at health effects associated with ambient oxidant levels in the individual's everyday environment, at long-term effects of exposures to ambient levels of oxidants, and at a wide range of potential health effects. These studies are limited, however, due to the kinds of data that are typically available, the difficulty of proving causality through statistical association, and the potential for unaccountable confounding factors. An example of an epidemiological study is the comparison of individual lung functioning among residents of two communities that typically experience different ambient oxidant levels. Even when a significant difference in lung function is found between the two groups, it is difficult to say for sure that this is the result of the difference in oxidant levels. Another difficulty that epidemiological studies face is how to define exposures for the individual. Monitored pollution levels in the community where the individual currently resides may not be a good indication of the individual's exposure, especially if long term effects are being considered, but this is often the only exposure information available. Finally, as examined below, the behavior of the studied individuals may significantly affect the estimated relationship between pollution and health effects.

2.1.1 Results of Studies Measuring Physical Health Effects of Oxidants

Both clinical and epidemiology study results suggest that oxidants adversely affect the health of members of sensitive populations, such as asthmatics, and members of the general population in certain circumstances.

Clinical studies on the effects of oxidants have found evidence of measurable changes in lung function in healthy subjects exposed to controlled amounts of oxidants for a few hours. (See Ferris, 1978, for a review of the health effects of air pollutants.) Subjects have been found to be more sensitive to oxidants when they are exercising. Sometimes these effects have been associated with noticeable discomfort on the part of the subject, but these effects appear to disappear when the exposure is reduced. Effects on lung function have been found at exposures as low as .12 ppm ozone (McDonnell et al., 1983). Some evidence has also been found that sensitivity decreases with repeated exposures (Folinsbee et al., 1980). In spite of this indication that long-term exposures may be less harmful, these kinds of studies do not provide conclusive evidence about the effects of long term exposures to low levels of oxidants.

A few clinical studies have used subjects with pulmonary diseases or illnesses to see how this affects an individual's sensitivity to oxidants. Linn et al. (1978) and Silverman (1979) both used subjects with asthma. Linn et al. found no significant change in pulmonary function at .2 ppm ozone, but found slight increases in reported symptoms. Silverman also found no significant change in pulmonary function at ozone levels of .25 ppm, but found that the volume of air breathed decreased for about one third of the subjects suggesting selective sensitivity. This kind of clinical evidence suggests that epidemiological studies may find health effects related to the respiratory system associated with short term and long-term exposures to oxidants.

Epidemiological studies done to date have examined effects on generally healthy individuals and on those with chronic respiratory problems, primarily asthma. Durham (1974) and Hammer et al. (1974) looked at acute respiratory symptoms in groups of students and how they fluctuated with daily oxidant levels. In both cases a significant relationship was found. Durham compared visits to student health centers for respiratory illnesses at different California universities, in locations with different oxidant levels, and found an approximatey 16 percent higher rate of respiratory illnesses at the higher pollution locations. Hammer et al. had a group of student nurses at downtown Los Angeles hospitals report daily symptoms of eye irritation, cough, chest discomfort and headache over a three-year period. He found a significant relationship between the percentage of students reporting symptoms on any given day and the daily oxidant level.

Some epidemiological studies have looked at differences in pulmonary function and/or chronic respiratory symptoms across residents in communities with different pollution levels. Linn et al. (1976) found no significant differences in chronic respiratory symptoms between office workers in Los Angeles and San Francisco. Average levels of oxidants and particulates are different between these two cities, although office workers spend much of their time in air conditioned offices and the differences in exposures may not be as large as for the average residents of the two cities. Detels et al. (1981) found reduced pulmonary function in residents of Glendora, California, a high oxidant area, relative to residents of Lancaster, California, a relatively low oxidant area.

An epidemiological study closely related to the current research effort was conducted by Whittemore and Korn (1980). They studied individuals (children and adults) with diagnosed asthma who lived in six communities in the Los Angeles area during the period 1972 to 1975. Respondents reported the frequency of asthma attacks on a daily basis for a 35-week period each study year. A total of 443 respondent years were obtained, although the same individual sometimes participated for more than one year. Daily oxidant levels were taken from monitor stations in or near each community. A significant relationship was found between whether or not one or more asthma attacks occurred and the levels of oxidants each day, controlling for whether the individual had had an attack the previous day, minimum temperature, humidity, wind, and day of the week. These results were significant for the group as a whole, although significant differences in sensitivity across individuals were found.

For the ongoing UCLA study (Gong et al. in progress), a group of asthmatics living in Glendora, California recorded their asthma symptoms daily for eleven months. Lung function tests were made on each subject every two weeks and medication use was monitored daily. Respondents measured their pulmonary peak flow twice daily. These data are being compared with daily oxidant levels, pollen counts, weather, and other factors that may influence the daily fluctuation in asthma symptoms. This is similar to the Whittemore and Korn study, but adds lung function tests, medication use, pollen counts and other potential confounding factors. Preliminary results of this study have not yet been released.

2.1.2 The Problem of Ignoring Mitigating Behavior in Physical Effects Studies

Both clinical and epidemiological studies may provide incomplete or biased information for use in an economic assessment by ignoring mitigating behavior. Studies of physical effects typically provide measures of the prevalence or incidence of some illness or physical effect due to air pollution. Human beings are not, however, passive with respect to their health. They can be expected to take action to minimize any harmful effect of exposure to environmental pollution (this may be particularly true for asthmatics and other groups with special health concerns). For example, if it is uncomfortable to exercise on days when air pollution levels are high, then some people will stop exercising on those days, use more medicines or change their location. This is a welfare effect of air pollution because individuals are giving up or changing desired behavior and/or expenditures. Individuals undertake such mitigating behavior because the welfare loss of the behavior change is less than the welfare loss of the health impacts that would have been expected to occur (see Section 2.3).

Epidemiological studies typically correlate measures of ambient pollutant concentrations and measures of health effects that actually have occurred. If asthmatics are taking any significant action to mitigate harmful effects of exposures to oxidants, then the estimated relationship between oxidants and health effects will be biased toward zero relative to the true underlying physical response relationship.[1] This is illustrated in Figure 2-2, where above some ambient oxidant level 0_3*, an individual may perceive pollutants as potentially adverse to her health and undertake defensive behavior to reduce the potential health impacts. Below 0_3* pollution, there may be no health effects, or she may perceive the "good" conditions and exercise more, spend more time outside, etc., thereby effectively increasing her 0_3 exposure compared to normal activities. (This "reverse mitigation" below 0_3 could lead to a stronger observed dose-response relationship in that range than would occur with no mitigation, as shown by the dashed line below 0_3*.)

This also means that oxidant levels at a fixed monitor station may be a biased measure of the individual's true exposure if his behavior influencing exposure changes systematically with the ambient oxidant level. These potential biases of epidemiology studies are directly translated into biases in economic studies that only estimate work loss and medical costs for changes in illness related to changes in environmental conditions. These economic studies are biased, at a minimum, because less illness is observed due to mitigation and because the value of mitigation behavior and expenditures are not measured. The individual may also make long-term adjustments to reduce his exposure to oxidants or to avoid aggravating his health in other ways. For example, an individual may choose to work at a less stressful and lower paying job or to participate in less strenuous or indoor leisure activities than he would if he did not have asthma or if his asthma were less severe. If air pollution aggravates his asthma this may be indirectly related to his job choice. These kinds of welfare damages are generally not captured in epidemiology studies or in economic assessments using epidemiological data and lead to understatements of damages from environmental pollutants.

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[1] This bias can be avoided through the use of personal exposure monitors (Ott et al. 1984, Johnson 1984).

Clinical studies may more accurately estimate the underlying air pollution-health relationship for the controlled situations they examine, but the use of these estimates in economic assessments will overstate economic damage.[2] This is because some health damage may be avoided or mitigated by individuals as a result of adjustments that cause lower welfare losses than would the health damage.

To address the importance of mitigating behavior in epidemiology and economic assessments of air pollution, the survey instruments developed in this research examined how the respondents in the UCLA study adjusted their behavior, both day to day and in general, in order to minimize their asthma symptoms. The analysis considers whether these adjustments are related to perceptions of air pollution levels and whether these perceptions accurately reflect changes in actual ambient air quality conditions.

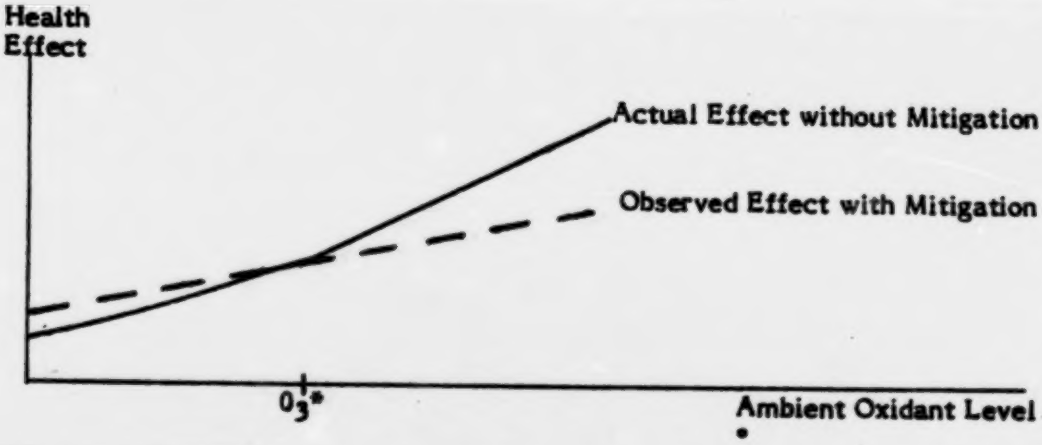

Figure 2-2

Potential Effect of Mitigating Behavior on the Observed Relationship Between Ambient Oxidant Levels and Health Effects

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[2] Syngergism with other pollutants in the real-life situation could make this overstatement less severe. Of course, if there is antagonism instead, the overstatement is more serious.

2.2 ECONOMIC STUDIES OF THE VALUE OF REDUCING HEALTH EFFECTS FROM AIR POLLUTION[3]

Economic approaches to valuing changes in risks of illness from exposure to air pollution involve assigning an economic measure of value to the associated change in well-being, or utility. The economic measure used to quantify this value is to determine how much of other goods and services, in dollar terms, the individual would be willing to give up in order to obtain the reduction in risks. The individual has a finite amount of resources (or income) to allocate among all desired uses. The maximum amount of these resources he is willing to allocate for a particular use is therefore a reflection of the value of that use. This is the concept behind the use of the consumer surplus "willingness to pay" measure of value for changes in environmental quality. (See Freeman, 1979 for a review of the concepts of economic values for changes in well-being related to changes in environmental quality).

Changes in air pollution control do not necessarily mean absolute changes in illness for any particular individual, but rather mean changes in the likelihood of illness for everyone in a given population group. Some groups will, of course, be more sensitive to exposures and therefore face higher risks than other groups, but it is still generally impossible to say exactly which individuals would be affected by how much. What is often desired, therefore, is estimates of WTP for changes in probability of illness. This would not be an important distinction if it could be assumed that willingness to pay for a change in the probability of illness equalled the expected value of the willingness to pay for the change in illness. The difference could be due to risk premiums.[4] While potentially important, these risk premiums are not considered in this analysis, which focuses upon changes in expected frequency of asthma attacks.

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[3] For a more complete review, see Chestnut and Violette (1984).

[4] For example, if an individual were willing to pay $50/month to prevent one additional asthma attack (with certainty) each month, then the expected value of the change in the risk of an asthma attack per month from .6 to .3 would be .3 of $50, or $15. There is, however, no reason to necessarily expect this to equal WTP to reduce the risk from 60 percent to 30 percent. Some individuals may be risk adverse and willing to pay more than $15 to obtain such a risk reduction. Others may not consider a change from 60 percent to 30 percent as valuable as some other 30 percentage point change, such as from 90 percent to 60 percent. In other words, the starting point level of risk may also be important.

The amount an individual will be willing to pay to reduce health incidences will depend upon the effects of the health incidences upon their expenditures, activities, and general sense of well-being, as well as depending upon their tastes and preferences and prices of good and services.

Illness associated with exposures to air pollution, just as any other type of illness, may interfere with the individual's ability to carry out his normal activities. When he is unable to work there will be a loss of income (except when there is paid sick leave). When leisure time is affected there will be a loss in utility due to the inability to participate as usual in recreational and household activities. Direct expenditures are also often made to prevent illness and to relieve discomfort and hasten recovery.

The individual may also take action to avoid or mitigate the health effects of air pollution exposure. For example, he may stay indoors on a high pollution day. This kind of action may involve a direct dollar expenditure or simply a loss in utility due to a change in activities or both.

In summary, an individual's WTP to reduce potential adverse health effects associated with exposures to air pollution are expected to include values related to the following damage categories:

1. Disutility associated with foregone income due to time off from work, lower wages or lower productivity at work due to illness.
2. Disutility from loss of ability to participate in desired leisure activities, household chores, child care and other activities.
3. Medical expenditures for treatment of illness.
4. Disutility from discomfort due to illness.
5. Disutility from mitigating behavior to prevent illness (preventive health care expenditures, inconvenience of activity changes, including when and where to work, recreate and live, etc.).
6. Risk premiums.

Two approaches have generally been used to estimate economic measures of value related to health: estimating values for some or all of the damage categories and summing them up, or attempting to estimate total WTP values through survey questionnaires.

2.2.1 Previous Empirical Work Concerning the Value of Reducing Morbidity — Damage Category Approaches

Estimates of the value of reducing morbidity associated with air pollution have, in most cases, been based upon estimates for several categories of damage identified above which are then summed for a total estimate of value. Most often this is based upon a cost of illness (COI) approach using the estimated medical expenditure and work loss associated with the illness. For recent examples, see Crocker et al. (1979), Ostro (1983), and Manuel et al. (1983). Income loss and medical expenditures are an appealing measure of the value of preventing increases in illness because it is easy to see that illness imposes these kinds of costs on society. The work of Cooper and Rice (1976) has been used frequently as a source for medical expenditure estimates. They developed estimates of total medical expenditures in the U.S. and allocated them across 16 broad disease categories. These data can then be used, for example, by assuming an air pollution induced x percent change in illness will be accompanied by a similar x percent change in medical expenditures. Alternative approaches to quantify medical costs of illness include primary surveys of expenditures, as is done in this report, or models and cross sectional data relating medical expenditures in specific categories in different locations to different rates of specific illness and other socioeconomic variables at the different locations.

Work loss or income loss has been another predominant approach for estimating the value of preventing increases in morbidity as a result of air pollution exposures. Work loss related benefit estimates are typically based upon epidemiology estimates of pollution levels and work loss days, which are made with several currently available data sources. Work loss days are then valued at a selected wage rate. Nationwide data on work loss days due to illness are available from several survey sources, including the Michigan Panel Study of Income Dynamics conducted by the University of Michigan and the Health Interview Survey conducted by the National Center for Health Statistics. These have been combined with ambient air quality data to estimate relationships between air pollution and work loss days by Crocker et al. 1979, Ostro 1983, and others. A work loss day is also a convenient measure of morbidity because it is a clear indication of an effect on the individual's well-being, it covers a very wide range of types of illness, and it is in some sense comparable across different individuals.

Using only work loss days (WLDs) misses impacts to activities that do not occur at work but may be valued by individuals. Some studies therefore use restricted activity days (RADs), available from some of the above mentioned surveys, which include work loss days. All RADs are then valued at a fraction of the wage rate or some other selected rate. If the selected per day value of RADs is a reasonable approximation to the value affected individuals put on such days, this is an improvement over just using WLDs, but still may not provide a WTP estimate based upon values for all potential damage categories. An exception is Loehman, et al. (1982), who specifically valued effects such as shortness of breath and eye irritation, rather than RADs.

Data on defensive activities and expenditures are not as readily available and are more difficult to attribute to air pollution. In general, the individual takes action to make himself feel better before an illness takes hold or to keep himself feeling healthy in response to any number of possible afronts to his health. These activities and expenditures are often associated with other benefits in addition to improved health, such as enjoyment from exercise. Lack of readily available data on these kinds of activities and expenditures and difficulty in determining how much they are motivated by the desire to improve health have made it very difficult to include them in estimates of the value of reducing morbidity when using secondary data.

Cropper (1981) made a preliminary attempt to include defensive activities and expenditures in an estimate of the value of reducing air pollution. She developed a model of investment in health that incorporates the possibility that the individual can influence his health with a variety of preventive health care activities. She then derived an expression for willingness to pay which consisted of the sum of the value of the reduction in time spent sick and the value of the reduction in preventive health care activities that are no longer needed. With the specific functional forms assumed for this model, the derived expression for WTP for changes in pollution was two times the value of the reduction in time spent sick. It appears, however, this result is due to the restrictiveness of the assumptions. Data from the Michigan Panel Study of Income Dynamics were used to estimate the derived willingness to pay.

Willett (1980) presents an example of a COI approach to estimating damages associated with asthma. Willett only considers costs related to visits to the doctor and the opportunity costs of bed disability days due to asthma. The latter included foregone earnings for employed individuals and the market value of daily housework for wives and husbands. Since hospitalization, pharmaceuticals, opportunity cost of leisure time lost and partially restricted days were not included, the resulting cost estimates are clearly lower bounds on actual costs associated with asthma.

Data on doctor visits and bed disability days for people with asthma in the Willett study were taken from the 1970 Health Interview Survey, an annual, nationwide survey by the National Center for Health Statistics. The subsample of respondents used for this cost study consisted of those individuals who reported only asthma as a chronic or acute abnormality. This was done due to difficulties in determining the cause of a doctor's visit or a bed disability day when more than one condition was reported. This subsample is, however, likely to be biased in favor of "healthier" asthmatics (those with no other chronic or acute illness), so that the costs for these individuals may understate average costs for all asthmatics.

The average annual number of doctor visits was 4.66 and the average number of bed disability days was 2.78. The variation in the number of doctor visits across different demographic and socioeconomic characteristics of the individuals was estimated. Doctor visits were significantly more frequent for individuals with more education (head of household's education level was used), more bed disability days, and more frequent asthma attacks. Every two additional bed disability days were associated on average with one additional doctor visit. Age, sex, race, family size, household income and asthma attack severity were found to be insignificant.

Doctor visit fees varied with specialty and region and ranged from about $8 to about $25 per visit. Daily earnings (in 1970 dollars) varied by industry and by region and ranged from about $19 to about $40. The average daily value of housework (in 1971 dollars) varied with the number and age of children and the wife's employment status. Daily value for employed wives ranged from $8 to $17 and for nonemployed wives ranged from $11 to $26. Daily values for husbands ranged from $1 to $8, depending upon the wife's employment status.

Overall sample averages were not calculated for each annual cost category, but the ranges of the national averages for each were provided as reported in Table 2-1.

It is presumed these values will be lower bounds for asthma as they do not include several important reduced costs (medicines, hospitals, special treatment program, etc.) and they do not include values for reduced activities, discomfort or other damages.

Table 2-1

Costs of Asthma from Willett (1980)

	Cost Category	Average annual cost per asthmatic***
(1)	Doctor visits (varies with doctor speciality)	\$ 83 to \$115
(2)	Bed Disabilities Days:	
	Earnings*	\$146 to \$262
	Housework**	
	Wife	\$54 to \$197
	Husband	\$7 to \$62
	Total (1) + (2)	
	Employed Husband	\$236 to \$439
	Housewife	\$137 to \$312

* varies with industry

** varies with # of children and wife's employment status

*** adjusted to 1983 dollars

2.2.2 Previous Empirical Work Concerning the Value of Reducing Morbidity — Direct Willingness to Pay Approaches

The direct approach to estimate total WTP for preventing illness requires either the use of behavior where tradeoffs between income and health are observed or the use of contingent valuation methods. Very little work has been done using either of these approaches for estimating the value of changes in morbidity and the results of these efforts are quite preliminary.

Several studies have estimated the wage premium associated with risks of fatal injuries on the job. (See Violette and Chestnut, 1983 for a review.) These studies have attempted to statistically isolate the difference in wages associated with different levels of risk of on-the-job injuries, holding constant other differences that would also influence the wage. This provides an estimate of how much the individual must be compensated in order to accept a small increase in the risk of on-the-job injury. A few of these studies have looked at wage premiums for both fatal and nonfatal injuries and developed estimates of wage premiums per injury or per nonfatal injury (Viscusi 1978 and Smith 1983). The results ranged from about $5000 to about $15,000 per injury, depending in part on whether the estimate was for all types of injuries or just nonfatal injuries (fatal injuries are a very small percentage of total injuries). There are several problems with interpreting these estimates as total willingness to pay to reduce risks of nonfatal injury. One is that many workers receive worker's compensation for on-the-job injuries so that the wage differences need not entirely compensate the individual for the higher level of risk. Another is that jobs with higher risks of nonfatal injuries also usually have higher risks of fatal injuries. This makes it very difficult to determine how much of the risk premium is attributable to risks of nonfatal injury versus fatal injury.

One study used a contingent market approach to estimate total WTP to prevent specific types of air pollution related symptoms. Loehman et al. (1979) used a mailed questionnaire asking how much respondents would be willing to pay to prevent mild or severe coughing/sneezing, shortness of breath, chest pain and head congestion for durations of 1, 7 or 90 days. The median total WTP responses ranged from about $2 to about $11 (1977 dollars) to prevent the symptoms for one day, with the responses for preventing minor symptoms being about half those for preventing severe symptoms. Willingness to pay was found to increase with income, percentage female and current days of illness. Total WTP for symptoms lasting 1, 7 and 90 days increased at a decreasing rate implying a decreasing but positive marginal WTP for incremental days.

The authors point out that these results provide value estimates that are considerably less than what income loss might be if suffering these symptoms for a day means missing a day of work. It is not clear, however, that respondents considered any of these symptoms severe enough to result in missing work. It is also not appropriate to compare these results to income loss without considering the effects of paid sick leave and values for illness on nonwork days.

2.2.3 What the Current Study Adds

Most economic studies concerning values for changes in pollution induced morbidity have used a COI approach. Because of the relative ease of collecting data on sick time and medical expenditures, the difficulty in interpreting the results of market-based studies such as wage risk studies, and the difficulties in conducting primary surveys related to every illness type potentially affected by charges in environmental quality, it is likely that variations on the COI approach will continue to be predominant in the future.

Harrington and Portney (1982) model individual utility maximizing behavior with respect to health from which they show that COI measures understate a more valid WTP measure — which includes COI plus the value of disutility of sickness (pain, etc.) and defensive spending to prevent sickness. The magnitude of this understatement has not been empirically addressed. In large part, this is because very little is known about the values for pain and discomfort and defensive activities and expenditures. The current study addresses this issue by comparing the magnitude of COI measures and WTP measures for changes in the incidence of asthma symptoms through the use of a contingent valuation survey instrument. It also provides additional evidence on the size and determinants of COI, total WTP and WTP for selected damage categories; and addresses methodological concerns in estimating WTP.

This study has a specialized sample since all of its members suffer from one type of chronic condition. What they are willing to pay to reduce risks of asthma attacks is not necessarily comparable to what a person without asthma might be willing to pay to prevent a cold, for example. The results in this sense are only applicable for a specialized type of morbidity and a specialized kind of population. The results concerning the importance of defensive activity adjustments and pain and suffering as part of total willingness to pay are, however, of general interest and can provide important guidance for future estimation efforts concerning the value of reducing risks of morbidity.

2.3 AN ECONOMIC MODEL

This section presents a formal economic model of consumer behavior that can be used to explain the choice to undertake mitigating behavior and expenditures, and the level at which they will be taken. It also formalizes the relationship between total WTP and COI measures of value for health risks. The model incorporates the concept of a health production function, which defines health as an outcome the individual produces using preventive medical care and health enhancing activities, given budget and technological constraints. This model is an outgrowth of the household production function consumer behavior theory developed by Becker (1971) and applied specifically to health by Grossman (1972). Harrington and Portney (1982) and Gerking et al. (1983) have applied this analysis to derive expressions for willingness to pay for changes in environmental pollution as it affects the individual's health.

The simple model presented here is a hybrid of the Harrington and Portney (1982) and Gerking et al. (1983) models and is used to illustrate the level of defensive expenditures and activities the individual will choose to undertake, the components of willingness to pay, and how epidemiological analyses can be biased when defensive expenditures are ignored. It is also used to demonstrate that willingness to pay for a change in pollution can be expected to exceed income loss and medical expenses incurred as a result of pollution induced illness. Generalizations of this model, as related to the questions addressed in the asthma survey, are then discussed.

2.3.1 A Simple Health Production Function Model of Consumer Behavior With Regard to Health Status

The basic premise of the health production function models is that the individual can be expected to take action to protect or enhance his or her health. People do not necessarily accept the effects of pollution passively, but may respond with actions that will mitigate the health effects that otherwise would have occurred. This premise does not necessarily require that people know what the effects of pollution are, or even that they know it is pollution that is affecting them. It merely requires that people respond when they feel their health may deteriorate with efforts to mitigate deterioration.

The individual's well-being, or utility, is assumed to be a function of the goods and services consumed and his or her state of health. The direct effects of the individual's state of health on utility would include pain and discomfort experienced during an illness.

$$U = U(X,H) \tag{2.1}$$

Where:

U = the individual's utility in a given time period

X = goods, services and leisure activities the individual consumes that are unrelated to his or her health, $U_X > 0$

H = the individual's state of health, $U_H > 0$

The individual's state of health (H) is a function of defensive expenditures and health enhancing activities undertaken, including such things as preventive medical care, exercise, and diet; exogenously determined levels of pollution; and biological, social and economic characteristics of the individual, such as congenital conditions, age and education, that influence the effectiveness with which he or she can maintain a given state of health. A simplifying assumption used here is that defensive expenditures and activities affect utility only through their effect on health. In reality many of these activities and expenditures jointly produce utility in other ways as well, such as the enjoyment of tennis or swimming produced jointly with the health benefit.

$$H = H(D,P,Z) \tag{2.2}$$

Where:

D = defensive expenditures and activities, $H_D > 0$

P = pollution, $H_p < 0$

Z = biological, social and economic characteristics of the individual, $H_Z \gtrless 0$

Time spent sick and medical expenditures made in response to illness enter the individual's budget constraint because they affect the amount of time and money the individual has for other goods, services and activities, but they do not directly enter the individual's utility function. These medical expenditures do not prevent additional illness, but may mitigate the discomfort and interference with activities that occurs.[5]

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[5] The distinction between D and M in this model is somewhat artificial in that many medical treatments are both defensive (reduce time spent sick) and responsive (mitigate the discomfort of time spent sick). Using the variables as defined in this model means that recuperative medical expenditures that reduce time spent sick or reduce the risk of future illness are included as part of D rather than part of M.

$$Ts = Ts(H) \tag{2.3}$$

$$M = M(Ts) \tag{2.4}$$

Where:

Ts = time spent sick, $Ts_H < 0$

M = medical expenditures in response to illness, $M_{Ts} > 0$.

The individual faces the following time and budget constraints.

$$X*Px + D*Pd + M*Pm = w*Tw + I \tag{2.5}$$

$$X*Tx + D*Td + M*Tm + Ts + Tw = T \tag{2.6}$$

Where:

Pi = price per unit of i, for i=x, d, and m
Ti = time per unit of i, for i=x, d, and m
Tw = time spent working
w = the individual's wage rate
I = nonwage income
T = total time available

Equations 2.5 and 2.6 can be combined into a "full income" constraint by assuming that all available time is valued at the wage rate and defining a combined dollar and time cost: $Qi = Pi + w*Ti$. Using w as the value for all time assumes that individuals choose to work to the point where the marginal benefits of working (the wage earned) just equal the marginal costs in terms of the value of time lost from other activities. This is a simplifying assumption and the effects of relaxing it are discussed in the next section. The full income constraint is:

$$X*Qx + D*Qd + M*Qm + w*Ts = w*T + I \tag{2.7}$$

Substituting with Equations 2.2, 2.3 and 2.4, the Lagrangian is:

$$\begin{aligned} L = \; & U(X, H(D, P, Z)) - \lambda(X*Qx + D*Qd + M(Ts(H(D, P, Z)))*Qm \\ & + w*Ts(H(D, P, Z)) - w*T - I) \end{aligned} \tag{2.8}$$

The first order conditions are as follows with subscripts denoting partial derivatives.

$$\frac{\partial L}{\partial X} = U_X - \lambda Q_X = 0 \tag{2.9}$$

$$\frac{\partial L}{\partial D} = U_H * H_D - \lambda \left(Qd + M_{Ts} * Ts_H * H_D * Q_m + w * Ts_H * H_D\right) = 0 \tag{2.10}$$

$$\begin{aligned}\frac{\partial L}{\partial \lambda} = w * T + I - X * Q_x - D * Q_d - M\,(Ts(H(D,P,Z))) * Qm \\ -w * Ts\,(H(D,P,Z)) = 0\end{aligned} \tag{2.11}$$

The first order condition for defensive activities and expenditures (Equation 2.10) indicates that the utility maximizing individual will engage in defensive efforts to the point where the marginal benefit equals the marginal cost. In this case the marginal benefit is the dollar value of the improvement in utility obtained with an additional unit of defensive efforts ($U_H * H_D / \lambda$) plus the medical expenditures that no longer have to be incurred as a result of a unit increase in defensive efforts ($M_{Ts} * Ts_H * H_D * Qm$), plus the opportunity cost of time no longer spent sick as a result of a unit increase in defensive efforts ($w * Ts_H * H_D$). The marginal cost is the unit cost of defensive efforts including both money and time (Qd). This means that the amount of defensive efforts undertaken will depend on the effectiveness of these efforts in maintaining health and on the costs and discomfort associated with time spent sick, as well as on the direct costs of the defensive efforts.

Willingness to pay for changes in pollution can be defined with the indirect utility function. Willingness to pay is the change in income that would hold utility constant when pollution changes. The indirect utility function is:

$$V = V(I, P, w, Qd, Qm, Qx) \tag{2.12}$$

One way to express willingness to pay for changes in pollution is to assume that the wage rate and other prices do not vary with pollution and to ask how it has to change in order to keep V constant as P changes. This defines an income compensated demand curve for P and the derivative of this function with respect to P gives the marginal willingess to pay for P. This demand curve can be denoted as I*(P) and it is defined such that

$$V(I', P) = V_0 \tag{2.13}$$

where V_0 is some fixed level of V and wages and other prices are constant. The total derivative of (2.13) is equal to 0 since V_0 is a constant. Therefore, the total derivative of V with respect to P is:

$$\frac{dV}{dP} = V_I * \frac{dI'(P)}{dP} + V_P = 0 \tag{2.14}$$

This can be written as:

$$\frac{dI'(P)}{dP} = - \frac{V_P}{V_I} \tag{2.15}$$

which says that the change in I that would hold V constant when P changes is equal to the negative of the ratio of the marginal utility of P to the marginal utility of I. This is an expression for willingness to pay for marginal changes in pollution.

Another expression for willingness to pay for changes in pollution can be obtained by substituting from the first order condition for defensive efforts into V_P and V_I.

$$V_P = U_H{*}H_P - \lambda\,{*}M_{Ts}{*}Ts_H{*}H_P{*}Qm - \lambda\,{*}Ts_H{*}H_P{*}w \tag{2.16}$$

$$V_I = \lambda \tag{2.17}$$

Substituting for U_H from Equation (2.10) and simplifying:

$$- \frac{V_P}{V_I} = - \frac{H_P}{H_D} * Qd \tag{2.18}$$

This says that willingness to pay for a marginal change in pollution is equal to the costs of defensive efforts that would (or would no longer) be needed to maintain health at a given level. Notice that, given the assumptions of the model, this expression for willingness to pay could be estimated without having to directly observe direct utility effects, changes in medical expenditures or changes in time spent sick but requires that the health production function (Equation 2.2) be known or estimated. This expression for WTP would no longer be accurate if the first order condition for defensive efforts did not hold or if the assumption that the only effect of D on utility is through H were not correct.

Harrington and Portney (1982) point out that cross sectional epidemiological studies that estimate a dose response relationship between health and pollution exposures are looking at the health effects that are observed to occur after defensive efforts have been made. This means that they are estimating the total derivative of H(D, P, Z) with respect to pollution rather than the partial derivative. The total derivative of H with respect to P is:

$$\frac{dH}{dP} = H_D * \frac{dD}{dP} + H_P \tag{2.19}$$

For an increase in P, the first term can be expected to be positive (indicating an increase in health) while the second term can be expected to be negative (indicating a decrease in health). The observed effect of pollution on health (dH/dP) is therefore less than what would occur without defensive efforts (i.e., if the first term were zero), so the benefits of preventing or reducing pollution are understated if defensive efforts are ignored.

Medical expenditures and time lost from work due to illness comprise the typical "cost of illness" estimate for changes in pollution. These costs are related to the total change in health that occurs as a result of a change in pollution. Therefore a cost of illness estimate for changes in pollution can be expressed in terms of the model as:

$$\frac{dC}{dP} = w * Ts_H * \frac{dH}{dP} + Q_m * M_{Ts} * Ts_H * \frac{dH}{dP} \tag{2.20}$$

Where:

C = the cost of illness

Note that the first term on the right hand side uses the wage rate as the opportunity cost of all time spent sick. This is an overstatement of what is usually included in cost of illness estimates, since these typically include only time lost from work. A typical cost of illness estimate can therefore be expected to be less than or equal to Equation 2.20.

The following discussion parallels the presentation of Harrington and Portney (1982) and examines the relationship between this expression for cost of illness and willingness to pay for changes in pollution.

From Equation (2.10) we know that:

$$\frac{U_H}{\lambda} - \frac{Qd}{H_D} = M_{Ts} * Ts_H * Q_m + w * Ts_H \tag{2.21}$$

Therefore:

$$\frac{dC}{dP} = \left[\frac{U_H}{\lambda} - \frac{Qd}{H_D} \; \frac{dH}{dP}\right] \tag{2.22}$$

Substituting from (2.19) and solving for the expression derived for willingness to pay for changes in pollution in (2.18):

$$WTP = - \frac{H_P}{H_D} * Qd = \frac{dC}{dP} + \frac{dD}{dP} * Qd - \frac{U_H}{\lambda} * \frac{dH}{dP} \tag{2.23}$$

On the basis of equation 2.23, willingness to pay for changes in pollution can be expected to exceed cost of illness because the second and third terms can be expected to increase WTP. The second term is the change in defensive expenditures associated with a change in pollution, and the third term is the dollar equivalent of the direct change in utility (i.e., the pain and discomfort) associated with the change in pollution. For example, an increase in pollution can be expected to cause the individual to increase defensive expenditures $(dD/dP) * Qd > 0$, and to have a negative effect on the individual's utility due to the discomfort of increased illness (i.e., $U_H, \lambda > 0$, and $dH/dP < 0$, so $-U_H/\lambda * dH/dP > 0$).

2.3.2 Discussion of the Model

This analysis of willingness to pay of asthmatics for changes in conditions that affect their asthma, including air pollution, is approached from the point of view of Equation 2.23, the expression for willingness to pay in terms of its various components. Two questions are the primary focus of this study:

1. Does WTP by an individual exceed COI incurred by an individual as Equation 2.23 predicts, and, if so, by how much?

2. What is the nature and extent of defensive efforts undertaken by asthmatics?

Not all of the simplifying assumptions of the model can be accepted in the analysis and require generalizations of the model. These generalizations are discussed below. While these generalizations of the model are not addressed algebraically, they are not expected to change the basic conclusion of the model that willingness to pay by an individual can be expected to exceed cost of illness incurred by the individual.

Value of Time Spent Sick

The simple model uses the wage rate as the value for all time. The basis of this assumption is analysis of consumer behavior that concludes that individuals will choose to spend their time earning money to the point where the marginal cost of earning money, in terms of opportunities forgone, just equals the marginal benefit, in terms of wages (and fringes), of working. There are several potentially problematic assumptions underlying this conclusion. One is that individuals can freely trade their time between work and leisure. The constraints of the standard 40 hour week make this difficult for many people. Although people do find ways to work overtime or part-time, they often face quite different wage rates when they choose to do so. Another assumption is that the only benefit derived from working is income. If people work because they enjoy it as well as earn money, then the wage rate will understate the true opportunity cost of their time. The use of the wage rate also leaves unclear the opportunity cost of time for people who choose not to work at a paid job.

The model could be generalized to incorporate different values of time for different activities. The conclusion that willingness to pay exceeds cost of illness would be unchanged unless the value of nonwork time were negative. Note that the expression for cost of illness, dC/dP, used in the previous equation denotes the value of all time spent sick and medical expenditures, while a more typical cost of illness estimate includes only income lost and medical expenditures. Nonwork time spent sick, even if valued at something other than the wage rate, could be expected to increase willingness to pay for changes in pollution relative to the usual costs of illness measures.

Social Costs Versus Individual Costs

The model assumes that all the expenses and inconveniences of illness are borne by the individual, ignoring the widespread availability of paid sick leave, medical insurance coverage and subsidized medical care. These are typically transfers of the costs of illness from the individual to others, rather than any additional cost of illness. The problem for the model is that the utility maximizing choices of the individual may be different if he or she does not bear the full costs. For example, if the price of medical care to the individual is less than the price to society, the individual may choose to use more medical care and incur lower defensive expenditures and less illness than he would if he faced the full price.

Equation 2.23 is still an appropriate expression for the individual's willingness to pay if the price of medical care (Qm) reflects the price to the individual, but it will understate society's revealed willingness to pay for that individual due to the medical care costs that are incurred on his behalf by others. Cost of illness estimates typically include all costs, regardless of who incurs them; therefore comparisons of willingness to pay and cost of illness estimates should take this into consideration. In this study, estimates are developed for total medical costs and for medical costs incurred by the individual.

The model also does not allow for any interdependence of utility among friends and family members. In reality one individual may be willing to pay something to prevent or reduce the illness of another, beyond any direct expenses that might be incurred due to the other's illness. The possibility that the health of others affects the utility of the individual could be incorporated into the model. Again, this would not appear to change the conclusion that willingness to pay is expected to exceed cost of illness.

Long-Term Health Effects

The simple model presented in the previous section is not suited for examining the effects of long-term changes in health. The model as presented considers only one time period and assumes that health in this time period is independent of health in previous time periods (except possibly through changes in Z). Chronic illnesses would have to be approached in a multi-period framework, because they can be affected by activities, expenditures and exogenous factors in previous periods and because they can affect health in future periods.

The subsequent analysis in this report considers both day-to-day fluctuations in asthma symptoms that may be aggravated by air pollution and more long-term adjustments individuals may have made in their lives due to the overall severity of their asthma. It is expected that asthma is aggravated, but not caused, by air pollution. It is possible, however, that a long-term change in the severity of an individual's asthma could result from ongoing exposures to pollution. Potential long-term adjustments such as job choice and residential location were covered in the survey of asthmatics, but primarily in a qualitative fashion. The individual's willingness to pay for changes in asthma could, however, include values for these kinds of long-term effects on his or her utility.

Joint Products of Defensive Activities

The simple model assumes that defensive efforts are undertaken to affect health only and do not affect utility through any other avenue. This is a restrictive assumption in that many defensive activities can be expected to produce utility in other ways as well. For example, exercise can be both enjoyable and good for you. Similarly, some activities, such as smoking, are enjoyable but have an adverse effect on health. This means that the utilty maximizing level of D will depend on many things in addition to the change in health that results from a change in defensive efforts. Rosenzweig and Schultz (1982), for example, examine the effects of the mother's activities and medical care on the health of the newborn and include a component in a similar model that contributes positively to the mother's utility and negatively to the child's health. It is not clear how this might change the expression for willingness to pay for changes in pollution.

Substitution Among Activities and Expenditures

Defensive behaviors will be taken in several different ways. They may be in the form of different types of preventative expenditures or changes in activities. For example, as air pollution increases, individuals may substitute from strenuous activities to more passive activities, or from outdoor activities to indoor activities. Each type of defensive behavior could be included within the model with separate time and price variables. The person would then optimize utility, choosing both the types and levels of defensive behaviors depending upon their individual costs. This generalization does not change the basic conclusions of the simple model. It has, however, been included in the analysis since changes in leisure activities were considered in examining the importance of defensive behavior in epidemiological estimates.

3.0 DESIGN OF THE ANALYSIS

This study was designed to supplement research underway at the UCLA Schools of Medicine and Public Health concerning the effects of air pollution on people with asthma. The UCLA study provided a unique opportunity to explore defensive behavior and other previously unquantified welfare effects with respect to air pollution exposure with a study sample of potentially pollution-sensitive people that already had been selected and currently were participating in a closely related research effort.

The economic analysis focused upon two issues:

1. The existence and importance of mitigating behavior upon epidemiological estimates of ozone damage to asthmatics, and
2. The relationship between COI and WTP economic damage estimates. Several methodological issues in WTP questionnaire design were also examined.

Three sets of survey instruments were used: The UCLA instruments on asthma severity, respiratory status, medicine use and behavioral data; the ERC daily diary of perceptions and activities; and the ERC general background activities and WTP questionnaire. These instruments and survey efforts are discussed below.

Further efforts along these lines will benefit from examining what worked and what did not work in these questionnaires and analyses. The results indicate the kinds of defensive behavior that may be significant for people with asthma. These could be examined fruitfully in more detail in future studies. Earlier involvement in the planning of a parallel medical or epidemiological study would be beneficial for such efforts.

3.1 THE UCLA ANALYSIS

The UCLA study was designed to determine the effect of day-to-day changes in air pollution on the respiratory symptoms of people with asthma. Data on daily asthma symptoms were initially collected for more than 90 subjects with diagnosed asthma over an eleven month period from January 1983 through November 1983. All of the subjects lived in Glendora, California throughout the study period, a town in the San Gabriel Valley east of Los Angeles where state and federal standards for ambient ozone and other pollutants are frequently exceeded. In order to minimize potential bias, the subjects were not told that pollution was a focus of the study.

The panel of subjects was recruited and selected in cooperation with the ongoing UCLA Chronic Obstructive Respiratory Disease (CORD) population study (Roger Detels, M.D., Principal Investigator). The CORD study was conducted in Glendora from March 1982 through October 1982, and attempted to include all residents in the selected census tracts. The information collected on the CORD participants helped to identify people with asthma who were then asked if they were interested in continuing to participate in the UCLA research efforts. The representativeness of the resulting panel of subjects was maximized since a high proportion of the residents in each census tract was contacted for the CORD study. This is an improvement over referrals from physicians and clinics in terms of minimizing sample bias.

Each subject in the UCLA panel was interviewed and examined to ensure his or her suitability and willingness to participate in the study and to provide background and baseline information. Throughout the eleven month study period, each subject kept a daily record of his or her asthma symptoms. These were measured in three different ways: 1) Subjects subjectively rated their daytime and nighttime symptoms in several categories on a 1 to 7 severity scale; 2) Subjects took twice daily readings of their pulmonary peak flow with a Mini-Wright Peak Flow Meter; and 3) Subjects used, as needed, an inhaler Nebulizer Chronolog that recorded the amount of medication used. Every two weeks the subjects brought their daily diaries to the research laboratory located in Glendora. On each bi-weekly visit the subjects were given more extensive spirometry tests and answered a few questions about any illnesses they may have had or other things that may have affected their asthma during the two week period. Questions or problems they may have been having with the daily diary were also addressed.

Air pollution levels were taken from the South Coast Air Quality Management District station #60. Previous studies have confirmed that this station's readings are representative of pollution levels in Glendora. Hourly measures for ozone, oxides of nitrogen, oxides of sulfur, carbon monoxide, hydrocarbons and fine and coarse inhalable particulates were also taken. Daily maximum and minimum temperatures, humidity and barometric pressure were recorded at the on-site Glendora facility. The daily type and amount of pollens and fungal spores, potential aeroallergens, were also measured with the use of a Roto-Rod continuous aeroallergen sampler at the on-site facility. Detailed research reports of the UCLA study results should be available in 1985 from the California Air Resources Board (CARB).[1]

3.2 THE ERC SURVEY PANEL AND PROCEDURES

The Energy and Resource Consultants, Inc. (ERC) study was designed to obtain additional information from the UCLA panel without interfering with the UCLA study. All of the participants in the UCLA study were given a letter and release form (both are shown in the Appendix) at one of their bi-weekly visits describing the study and asking for their participation. Subjects age 16 and over (we refer to this as the adult group) were asked to complete the daily diary at home each day for four weeks and then to complete the general questionnaire during a later visit to the UCLA facility. The parents of subjects under 16 years old were asked to complete the general questionnaire only. In keeping with compensation rates offered in the UCLA study, those who completed the diary and the questionnaire were offered compensation of $40, and those who completed the questionnaire only were offered $15.[2] Sixty-four of the then current 65 adults and all eighteen parents of the panelists under 16 agreed to participate. Complete responses were obtained from each of these participants.

The adults who agreed to participate were then given daily diaries for a two-week period and were taken through the instructions by the interviewer. Several of the questions referred to "bad asthma days" so as to determine how the subject adjusts his or her activities when his or her asthma is "bad" or when the subject is concerned that it might be "bad". Of course, what is "bad" will be different for every individual. Each subject was therefore asked to pick the highest rating on the seven point UCLA severity scale that he or she would still consider to be a "good asthma day" (see page A-5). The subject was then told that when the questions referred to a "bad asthma day" it meant any day on which he or she would rate his or her asthma sypmtoms higher (worse) than the selected point.

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[1] Dr. Henry Gong, M.D. is the principal investigator at UCLA. The CARB representative is Dane Westerdahl. The UCLA daily diary is reproduced in Appendix A as it illustrates the severity scale calculation later used in the ERC questionnaires. The other UCLA instruments are available from CARB.

[2] The forms in the Appendix indicate $25, but were altered during the solicitation to reflect the two levels of potential participation and to be more in keeping with the UCLA compensation rates.

The subjects were encouraged to call the interviewer at the Glendora facility if any problems or questions arose when they tried to complete the diary. The subjects brought their completed diaries to their next regular bi-weekly visit to the Glendora facility where the interviewer was able to look over the responses and clarify any apparent problems and then gave them another set of diaries for the second two-week period. During the remainder of the study period, completed diaries were turned in at the subsequent bi-weekly visit. The diaries were produced on heavy stock so as to withstand a week of nightly responses.

All of the participating adults and the participating parents answered the ERC general questionnaire at their final visit to the on-site facility. Since the data collection for the UCLA study was completed at this point, this minimized the possibility that participating in this study would introduce any bias into the UCLA results. The questionnaire was completed in interview style with the interviewer recording the answers. A respondent notebook that included some of the longer and more complex questions was used to help the respondent select his or her answers. The questions for the children under 16 years old were directed to the parent, but in most cases the child was also present and participated to some extent in answering the questions.

3.3 THE ERC SURVEY INSTRUMENTS

Draft versions of the daily diary and the general questionnaire were developed by ERC. These were then carefully reviewed by the UCLA research team and by EPA and CARB staff. The entire project team (ERC, UCLA, and EPA) then met at UCLA to discuss the comments and determine the necessary modifications. The participation of the UCLA research team was very important at this stage because of their familiarity with the subjects and with the medical aspects of asthma and potential air pollution effects. The final survey materials are included in the Appendix. They are described and discussed in the following sections.

The ERC Daily Diary

The purpose of the daily diary was to supplement the information gathered by UCLA concerning daily asthma symptoms with data about how the subject may have changed his or her activities in response to or in anticipation of worse than normal asthma symptoms. There are several questions to be addressed through the diary:

- Do individuals perceive air pollution as affecting their asthma and do their perceptions about air pollution accurately correlate with ambient conditions?
- When individuals anticipate having a bad day due to air pollution, do they alter their behavior to reduce or minimize the effects? This defensive behavior both affects epidemiologic estimates and represents a change in well-being often ignored in economic estimates of morbidity.
- How does having bad asthma symptoms on any day affect the individual's perceived well-being?

The first diary question asks the respondent to identify anything that he or she anticipated affecting his or her asthma that day. Included in the choices offered were air pollution, pollen, stress, a bad day yesterday and weather. Combining the answers here with those to other questions helps identify when and how people change their activities in anticipation of a potential aggravation of their asthma, and specifically to avoid undesirable affects of air pollution. It can also be used to check the person's perceptions against actual air quality conditions. The second question is related to the first and asks whether the respondent thought he or she might have a bad asthma day that day. This helps identify whether they anticipated a bad day and took steps to avoid it.

Question 3 asks how asthma symptoms affected the respondent's work, schoolwork or household chores that day in terms of enjoyment, performance and changes in the amount of time spent at work. This provides information on whether well-being was reduced by a bad asthma day and could be combined with UCLA analyses to provide information for better estimates of work loss as compared to the person's normal work activities. Question 4 asks how many hours were spent in several categories of household and leisure activities. These can be related to whether they anticipated a bad day and to the asthma rating for that day to determine if there were a predictable change in the allocation of time when the person anticipated a bad asthma day or actually experienced a bad asthma day. This is of particular interest if air pollution is identified as a factor that may aggravate asthma on a bad day.

Questions 5 and 6 specifically ask the respondent whether he or she changed his or her leisure or sleep activities in order to avoid or to prevent worsening a bad asthma day. The answers help verify whether changes in behavior were related to actual or anticipated bad asthma symptoms and help identify days on which averting behavior was undertaken.

A few problems with the design of the diary emerged as responses and questions came in. One was that Question 4 should have included a category for time spent sick. Another approach that was initially considered was asking for an allocation of all 24 hours each day. This was rejected as being too complex and time consuming for the take-home diary, in part because we were concerned that a time consuming ERC diary might interfere with the completion of the UCLA diary. Future efforts might want to consider other ways of approaching this. Problems also arose with the questions about time off from usual work schedule. It was apparently not clear to all the respondents that this refered only to changes in the normal work or chores schedule because a few respondents answered 24 hours on one or more days. There were also some ambiguities as to whether people who were employed should consider the time they usually spend doing household chores as part of work time and whether time spent sick or asleep should be included in the inactive leisure category. The question regarding changes in sleep was problematic because asthma symptoms generally interfere with sleep. Other suggested revisions include a check as to whether this was a normal day as far as work or chores, or a vacation/leisure day. This dicotomy affects the hours distribution and had to be inferred from that distribution and the calendar. Questions 5 and 6 could have been combined into one question concerning leisure, work, chores or sleep. Finally, it should be noted that Los Angeles experienced an unusually high amount of rain during the October-November 1983 study period that may have affected the distribution of hours reported.

The ERC General Questionnaire

The purpose of the general questionnaire was to identify ways in which asthma affects people's well-being, and where possible to estimate economic measures of changes in well-being associated with changes in the frequency of asthma symptoms. A goal was to compare COI estimates to WTP estimates, so as to determine the relative importance of WTP components typically omitted in COI studies.

After the meeting of the project team, the general questionnaire was revised, informally pretested with a few asthmatics in the Denver area, and final edits were made. Final versions of the survey instruments are included in the Appendix.

The questionnaire for the adults consists of seven parts. Each of the first six parts addresses a particular damage category. The seventh part includes a ranking of the damage categories and a total WTP question. This structure allowed data to be gathered to compare the importance of the individual damage categories and to explain and verify the rankings and total WTP amounts. It also allowed the respondent to think through all the damage categories before ranking them and answering the total WTP question. It was hoped this structure would increase their accuracy in answering the important questions in Part VII.

Part I asks about whether there were other asthmatics in the household and, if so, about the relative severity of each person's asthma. This is to help determine the importance of the respondent's asthma in a household with more than one asthmatic. In such households asthma related expenditures and residential location choices may be related to all of the asthmatics in the household. Therefore, the expenditure data were adjusted to values for the respondent by using a weight of his asthma severity relative to the total household's asthma severity. This part was skipped if the respondent was the only asthmatic in the household.

Part II concerns asthma-related expenditures. Data were collected to quantify the medical cost component of asthma and its relationship to asthma severity. Respondents were asked to estimate annual household expenditures for periodic purchases related to asthma, such as asthma medication and special equipment, and to estimate one-time expenditures, such as air purifiers. Respondents were also asked whether insurance covered each of these expenses. If they did not have insurance coverage, they were asked if their asthma was the reason. Questions about their most recent hospital and doctor visits were also included in order to help determine appropriate cost estimates for these visits. Frequency of hospital and doctor visits was available from the UCLA background and bi-weekly questionnaires so these were not asked again.

Part III includes questions about how asthma affects work and/or school for the respondent. Many economic studies use only work loss days as a measure of job and income impacts. This approach ignores potential long run impacts such as job choice and performance. Many of the questions in this section are qualitative and address the potential importance of the effects of asthma upon aspects of current employment status, job choice and performance at school. This provides one indication of [illegible] potentially important economic effect of asthma severity that would not show up in day-to-day variations in activities.

For those who were employed, willingness to pay questions were asked about what change in wages they would accept (or require) in order to obtain (or accept) working conditions that were better (or worse) for their asthma. To ensure that the scenario was realistic for each individual, they were first asked whether they believed that their asthma could be better or worse under different working conditions than they currently had. The WTP question was only asked if they answered "yes". They were asked to estimate the biggest reduction in pay that they would accept in order to have similar working conditions under which they would have half as many bad asthma days as they currently have and to estimate the smallest pay increase they would require in order to take a job where they would have bad asthma days twice as often. Zero bids and refusals were probed to determine whether they were truly zero valuations for the asthma change or were rejection of the bidding vehicle. This approach, if credible to the respondents, provides a private payment vehicle (their wage) to measure WTP as an alternative to the public program tax vehicle used below. There may, however, be some uncertainty in interpreting and comparing the responses if the individual considered asthma symptoms experienced only at work rather than a change in all symptoms, or if the respondents perceived working conditions other than pay and asthma severity to also change. These questions were viewed as more "experimental" than the tax bid WTP question discussed below.

Part IV asks about the effect of asthma on cooking, cleaning, child care, yard work, house maintenance and volunteer work to examine welfare losses and expenditures on non-paid chores as related to asthma severity. They were first asked whether their asthma affects their ability to perform these kinds of chores. Those who said "yes" were asked if the household hires any outside help with these chores because of the respondent's (or the household's) asthma. This is an economic cost that could be expected to be related to asthma severity, although there are obvious joint benefits in simply not having to perform some of these chores. Participants were also asked how a bad asthma day usually affects chores, such as cooking and child care, that have to be done and that they usually do.

Part V asks whether asthma affects leisure activities and probes in a very general way how leisure activities are changed in response to a bad asthma day. This allows better quantification of the concept and valuation of restricted activity days. A question was also asked about sick days in the general questionnaire since the daily diary had failed to include sick time as a category of activities.

Part VI concerns residential location. Respondents were asked how long they had lived in the area and whether they owned or rented their homes. Both of these factors could result in differences in willingness to move and therefore differences in the responses to the subsequent questions. The residential location questions were somewhat constrained because the respondents were living in Glendora, so the sample did not include any people who had chosen to live in a clean air area. The questions therefore address whether they think where they live affects their asthma, and if so, whether they ever have considered or would consider moving. Moving would obviously be associated with economic, social and pychological costs, although no attempt was made to quantify these.

Part VII of the questionnaire asks the respondents to rank in importance the categories of benefits they might receive if their asthma improved. These categories follow from the questions in the previous sections and include lower medical expenditures, higher wages or productivity, more flexibility about where to live, better chance to participate in leisure activities, and less pain and suffering or discomfort. The results of the ranking with respect to residential location should be interpreted in light of the fact that all of the respondents had chosen to live in a high pollution area and that it is likely that the impacts of asthma on their desired residential location could be less important than for other samples of asthmatics or sensitive population groups.

After the ranking, repondents were asked how much they would be willing to pay in additional taxes each year for a program that would reduce their bad asthma days by one-half. A payment card approach was used. Zero bids and refusals were again evaluated to determine whether they were true zero valuations for a reduction in bad asthma days or were rejections of the vehicle. The medical cost data and ranking questions also help to analyze the internal consistency of an individual's WTP reponses. The final question was household income. Other socioeconomic variables were available through the UCLA questionnaires.

The questionnaire for the parents of subjects who were under 16 years old covers all of the same questions that are relevant for the children and their households. The sections omitted were the employment questions and the non-paid chores questions.

After implementation, some problems and suggested modifications to the questionnaire were identified. It would have been more effective and accurate to ask the number of visits to the doctor and hospital in the last year than simply whether they went. Using the UCLA data on visits presented some difficulties as they were for a year earlier and there is often substantial year-to-year variation in the number of visits. To reduce respondent burden on a long questionnaire, we asked only if they had insurance coverage, not the amount of coverage. This introduces some measurement error.

The wage WTP has additional interpretation problems because current job status, which also affected hours missed from work on the daily diary during the October-November period, was not representative of the remainder of the year for some respondents due to changes in permanent or seasonal job status. Finally, the rankings and WTP can only be interpreted in terms of the costs and values to the individual, not society. Consequently, insurance coverage and paid sick leave may cause a divergence between the costs and rankings of the individual and society. This is addressed in the analysis below.

4.0 RESULTS

This chapter presents the results from the daily diary and general questionnaires in the order in which the questions occur on these instruments. Some of the statistical analyses are still considered to be of a preliminary nature.

Many of the analyses incorporate a measure of asthma severity. An asthma severity measure based upon a weighting of medication use and the intensity of actual asthma incidences is being developed by UCLA researchers but was not available in time to be used in this analysis. Therefore, this analysis uses a severity measure based upon the individual respondent's own reporting of asthma frequency (F_i) and intensity (D_i) for each month of the year. These measures were taken from the UCLA general questionnaire, which asked respondents to separately rate their asthma frequency and intensity on a 1 to 7 scale (similar to the scale shown on page A-1) for each month of the year. Severity was defined as:

$$SEV = \sum_{i=1}^{12} F_i * D_i \qquad i = 1,2...12$$

The mean and standard error of the mean for SEV, based upon all respondents, are 173 and 6.7, respectively. F_i and D_i were also individually tested as potential severity measures, but were found to have less explanatory power than SEV.

A summary of the variable names used throughout this chapter is found in Table 4.4, page 4-6.

4.1 DIARY RESULTS

4.1.1 General Results

Each of 64 adult respondents completed the diary for an average 27.8 days resulting in a total of 1779 observations (or person-days). Individuals started the diary anywhere between October 12 and November 2, 1983 depending upon their schedule of visits to the UCLA Glendora facility. Since the observation period occurred in the fall of a year with an unusual amount of rain, there were only 13 days with peak hourly ozone readings in excess of 12 pphm (the federal standard) in the Glendora area (see Table 4.1), although peak hourly readings above 30 pphm are not uncommon earlier in the summer in this area. The respondents checked air pollution as a factor potentially aggravating their asthma on only 292 person-days (16.4 percent of the total). The infrequency of this response could have been the result of the unusually low pollution levels. Table 4.2 summarizes responses to the daily diary for the full sample and for days when air pollution was checked.

For analysis purposes, the diary data were analyzed with both the "full sample" of 64 individuals (1779 observations) and a "reduced sample" of 32 individuals (866 observations) who checked air pollution as a possible factor aggravating their asthma on one or more days. It was felt that those individuals who never indicated air pollution as a factor were, in their opinion, either not concerned about or were not aware of air pollution at the levels experienced during the study period, and could not be expected to alter their behavior in response to air pollution, which was the relationship of interest.

4.1.2 Perceptions About Air Pollution

As noted above, air pollution was checked 16.4 percent of the time as a factor potentially aggravating the respondents' asthma. For those days where air pollution was checked, respondents were more likely to check certain other factors as potentially aggravating their asthma. These factors were tension, stress and anxiety; animals, plants and pollens; and weather. This suggests that asthmatics perceive that air pollution is more likely to affect their asthma when other factors are also present and/or vice versa.

On days when individuals checked air pollution they were about twice as likely to expect a bad day; to have a less enjoyable day; to have their performance at work, school work or chores adversely affected; and, to change their leisure or sleep activities.

Simple correlations suggested that perceptions of air pollution and ambient concentrations are fairly consistent. This is borne out by simple regressions of whether air pollution was checked versus actual readings and other explanatory variables (Table 4.3).

Table 4.1

Oxidant Readings in Glendora, California

October 12 - November 29, 1983

Date	Maximum Hourly Reading (pphm) (AQ1)	Daily Average (pphm) (AQ2)
October		
12	16	7.1
13	10	5.3
14	9	3.9
15	8	3.0
16	14	5.0
17	8	2.8
18	16	5.3
19	19	7.3
20	18	5.8
21	19	6.0
22	15	6.1
23	15	6.2
24	13	4.0
25	5	3.4
26	9	4.4
27	9	4.6
28	14	5.9
29	13	4.7
30	7	3.3
31	5	1.7
November		
1	4	2.4
2	8	3.3
3	6	2.8
4	13	4.5
November		
5	9	3.3
6	15	5.5
7	12	3.6
8	9	4.8
9	4	2.0
10	6	2.4
11	2	0.8
12	1	0.1
13	4	0.7
14	4	1.0
15	3	1.6
16	8	1.8
17	1	0.4
18	3	0.7
19	7	2.2
20	3	1.2
21	4	2.2
22	4	2.3
23	4	2.3
24	4	2.4
25	3	2.0
26	4	2.7
27	6	3.3
28	6	3.3
29	9	4.9

Simple Pearson Correlation (AQ1, AQ2) = .7265

Source: California Air Resources Board, 1984

Table 4.2
Frequency of Responses on the Daily Diary

GLENDORA-ASTHMA BEHAVIOR AND EXPENDITURE STUDY
WEEKLY DIARY FORM

CODE #__________

Date this diary started ______ month ______ day

October - 38.1%
November - 61.9%
64 Respondents (Adults Only)

Date							
Day			All	Respondents,	Days	when	

1. WHEN YOUR DAY STARTED, WHAT DID YOU FEEL MIGHT AFFECT YOUR ASTHMA TODAY? CHECK ALL THAT APPLY.

	All Respondents, All Days (1779)	Air Pollution Checked (292)
I DIDN'T EXPECT ANY SYMPTOMS TODAY	43.3%	16.4%
ILLNESS, COLDS, FLU	14.3%	15.8%
TENSION, STRESS, ANXIETY	21.9%	36.6%
EXERCISE	8.8%	14.7%
AIR POLLUTION	16.4%	--
ANIMALS, PLANTS, POLLENS	17.9%	43.2%
WEATHER	22.3%	34.9%
A BAD DAY YESTERDAY	13.0%	12.3%
NOTHING IN PARTICULAR/DON'T KNOW	12.3%	.7%
OTHER (SPECIFY)	6.9%	8.6%
	177.1%	183.2%

2. WHEN YOUR DAY STARTED, DID YOU THINK YOU MIGHT HAVE ASTHMA SYMPTOMS THAT WOULD RESULT IN A BAD ASTHMA DAY (EVEN IF THEY DID NOT OCCUR)?

YES	33.8%	49.7%
NO	66.2%	50.3%

3. HOW DID YOUR ASTHMA SYMPTOMS AFFECT YOUR WORK, SCHOOLWORK OR HOUSEHOLD CHORES TODAY COMPARED WITH MOST GOOD ASTHMA DAYS? CHECK ALL THAT APPLY.

MORE ENJOYABLE	14.2%	13.7%
LESS ENJOYABLE	30.9%	55.8%
MY PERFORMANCE WAS IMPROVED	11.6%	14.7%
MY PERFORMANCE WAS REDUCED	26.6%	48.3%
I TOOK TIME OFF COMPARED TO MY USUAL SCHEDULE	10.1%	16.8%
ENTER # OF HOURS TAKEN OFF	3.87	3.4
NO EFFECT	52.5%	31.8%

4. IN THE LAST 24 HOURS, ABOUT HOW MANY HOURS DID YOU SPEND IN EACH OF THESE TYPES OF ACTIVITIES?

INDOOR HOUSEHOLD CHORES	2.2 hrs.	2.76
OUTDOOR HOUSEHOLD CHORES	.98 hrs.	1.56
ACTIVE INDOOR LEISURE	.815 hrs.	.85
INACTIVE INDOOR LEISURE	4.07 hrs.	3.32
ACTIVE OUTDOOR LEISURE	.9 hrs.	.753
INACTIVE OUTDOOR LEISURE	.83 hrs.	.96
	9.8 hrs.	10.2

5. DID YOU CHANGE YOUR LEISURE ACTIVITIES (TIMING OR # HOURS) TODAY TO AVOID HAVING OR WORSENING ASTHMA SYMPTOMS THAT YOU WOULD CONSIDER TO BE A BAD ASTHMA DAY?

YES	16.5%	
NO		26.7%

6. DID YOU CHANGE YOUR SLEEP ACTIVITIES (TIMING OR # HOURS IN BED) TODAY TO AVOID HAVING OR WORSENING ASTHMA SYMPTOMS THAT YOU WOULD CONSIDER TO BE A BAD ASTHMA DAY?

YES	16.2%	
NO		22.2%

Worst Good Day Value %-All Respondents

1	2	3	4
3.1%	29.8%	49.5%	17.5%

% with Rating =

	1	2	3	4	5	6	7
All Respondents	29.6	21.1	25.5	16.8	5.7	1.1	--
(Air Pollution Checked)	13.4	24.0	38.0	17.5	6.8	.3	--

Table 4.3

Regressions Relating Air Pollution Perceptions to Actual Air Pollution Values
(t-ratios in parentheses)

Dependent Variable = A5

Sample Set	Full Sample		Reduced Sample*	
Models	1	2	3	4
Explanatory variables				
Constant	.165 (3.5)	.149 (3.2)	.358 (3.7)	.346 (3.6)
AQ1	.935 E-2 (5.3)		.18 E-1 (5.8)	
AQ2		.27 E-1 (5.78)		.50 E-1 (5.9)
SEV	.976 E-4 (.69)	.969 E-4 (.69)	-.18 E-3 (.69)	-.19 E-3 (.74)
INC	-.805 E-6 (1.47)	-.818 E-6 (1.50)	-.82 E-6 (.77)	-.86 E-6 (.81)
AGE	-.290 E-4 (.04)	-.85 E-5 (.00)	-.89 E-3 (.78)	-.95 E-3 (.86)
SEX	-.122 (6.48)	-.121 (6.48)	-.191 (5.65)	-.191 (5.65)
R^2	.20	.21	.29	.30
F	14.71	15.83	16.2	16.5
NOBS	1779	1779	866	866

See Table 4.4 for variable definitions.

* The reduced sample is all days for 32 individuals who on one or more days checked air pollution as a possible factor aggravating their asthma.

Table 4.4

Definition of Variables

Name	Definition	Source
AQ1	Maximum Hourly Reading (pphm)	CARB
AQ2	Daily Average (pphm)	CARB
A5	= 1 if Air Pollution is expected to affect their asthma = 0 if Otherwise	Diary
SEV	Severity of Asthma (see page 4-1)	UCLA
INC	Income	General
AGE	Age	UCLA
SEX	Sex; 0 = male, 1 = female	UCLA
CI	Hours in Chores Indoor	Diary
CO	Hours in Chores Outdoor	Diary
ACIN	Hours in Active Indoor Leisure	Diary
ACOUT	Hours in Active Outdoor Leisure	Diary
ININ	Hours in Inactive Indoor Leisure	Diary
INOUT	Hours in Inactive Outdoor Leisure	Diary
WKLOSS	Hours off of usual work/school/chores Schedule	Diary
EXPECT	= 1 if respondents expect they might have a "Bad asthma day", = 0 otherwise	Diary
MEDVHH	Variable medical costs/year paid by the household for this asthmatic (Doctors, hospitals, medicines, etc.)	General
RTFM	Respondent's share of total household asthma (0-100%)	General
LIVE	Asthma effected by where they live? Yes = 1, No = 0	General
JC	Asthma affects job choice? Yes = 1, No = 0	General
SCHOOL	Asthma affects performance at school? Yes = 1, No = 0	General

Table 4.4
(continued)

Name	Definition	Source
LA	Asthma affects leisure activities? Yes = 1, No = 0	General
INSURE	Insurance or other program that pays the majority (assumed 80%) of medical expenses? Yes = 1, No = 0	General
CHHIR	Chores hired out due to asthma? Yes = 1, No = 0	General
GDAY	Highest day rating on UCLA scale still considered to be a good day	Diary and General
NBAD	Number of bad days/year — number ofdays where the day rating is greater than GDAY	UCLA
NBADR	1/2 NBAD = Number of days reduced in WTP scenarios	—
UNEMP	Respondent's employment status Unemployed = 1, Employed = 0	General
ADULT	Is the respondent an adult (16+ years)? Yes = 1, No = 0	General
OWN/ RENT	Does family own or rent their residence? Own = 1, Rent = 0	General
TAXBID	WTP responses to reduce bad asthma days by half through a tax vehicle	General
NOBS	Number of observations used in the analysis	—

UCLA = UCLA Survey Instruments

Diary = ERC Daily Diary Survey Instrument

General = ERC General Questionnaire

A logit analysis would likely be more accurate, as the simple linear regressions with a (0,1) dependent variable are subject to heteroskedasticity problems and overstate the likelihood of checking air pollution as a causal factor at low air pollution values and understate the likelihood at high air pollution values (see Pindyck and Rubinfeld, 1976, page 237). Nevertheless, the high statistical significance of the simple linear analysis suggests that the probability of checking air pollution is highly related to actual ambient levels and that men are more likely to be aware of air pollution.[1] Further, awareness of air pollution is not related to our measure of severity. The regressions in Table 4.3 for the reduced sample (of those 32 individuals who on one or more days checked air pollution) suggest that for a day with a peak hourly O_3 value equal to the federal standard of 12 pphm, 48 percent of the males and 29 percent of the females will observe the air pollution and expect it to affect their asthma (26 percent and 13 percent of all asthmatics in the sample.)

On those days when air pollution is checked, asthmatics are 62 percent more likely to expect a "Bad Asthma Day" than when air pollution is not checked. This is a significant increase in the expectation of a bad asthma day that is not related to the asthma severity of the respondent. It should be noted, however, that when respondents expected air pollution to affect their asthma they were more likely to expect certain other factors to also affect their asthma that day, suggesting that concerns about air pollution and expectations of a "Bad Asthma Day" are amplified when other adverse factors are present.

4.1.3 Expectations, Behavior and Outcomes

Epidemiology studies attempt to relate ambient concentrations of a factor affecting illness to observed illness levels. Yet economic theory suggests that, if people are aware of factors affecting illness, they may take actions to mitigate their exposure, and thereby reduce the amount of illness that actually occurs. Thus, it is of interest to see what percentage of the respondents to this survey expected a bad asthma day and attempted to avoid having or worsening it.

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[1] Other air pollutant variables could also be included in the equation to verify that asthmatics were responding to ozone. To the degree that changes in the concentrations of ozone and other pollutants are colinear, the effect of mitigating behavior on epidemiology estimates remains. While exact measurements were not available in time for ERC's analyses, it is known that the level of other air pollutants was quite low during the study period. Similarly, the use of a model with lagged ozone values may improve the analysis.

Figure 4.1 presents one way of categorizing the diary responses into whether a bad day was expected, whether anything was done to avoid a bad day or respond to it and whether a bad day occurred. Whether the individual expected a "bad asthma day" was determined by their response to Question #2. Whether they changed their behavior was determined by the listing of a non-zero amount for time-off work/chores/school in Question 3 or by checking yes to Questions 5 or 6. These measures may understate changes in behavior by ignoring alteration in the location or time of day activities were undertaken. Whether they had a bad day was determined by comparing their rating for each day (from the UCLA diary form) with their stated "worst good day" value (GDAY).

Eight possible outcomes are defined in Figure 4.1. Outcomes 1,2,5 and 6 reflect no changes in behavior. Outcomes 3 and 7 would be expected to reflect changes in behavior to mitigate potential adverse asthma symptoms, and outcomes 4 and 8 would be expected to reflect changes in behavior to mitigate and/or respond to adverse asthma symptoms that end up occurring. Results of epidemiology studies would be potentially biased by observations in outcomes 3, 4, 7, and 8. Outcome 3 is an interesting case where respondents apparently do not expect a bad day when the day starts but undertook mitigating activities. They may not have expected a bad day due to anticipated mitigation during the day, or they may have changed their expectations during the day and then undertook mitigating activities.

The percentage of people in each outcome for each subsample are listed in Table 4.5. In general, there is a substantial portion of the observations (up to 23.7 percent of the full sample) in outcomes that are related to behavioral changes to minimize adverse asthma symptoms (outcomes 3, 4, 7, 8). Respondents who checked air pollution were more likely to have a bad day than when air pollution was not checked (29.0 percent to 24.7 percent). On days when respondents checked air pollution, they were much more likely to take mitigative and responsive action (outcomes 7 and 8) than when a bad day was not expected (outcomes 3 and 4) and more than twice as likely to take mitigating actions to prevent a bad day when it was expected (outcome 7). It is, however, curious that across all respondents there is a substantial percentage of days where they expected a bad day, did nothing and did not have a bad day (outcome 5). This could be a problem in the measure used to determine whether they changed their behavior to avoid having or worsening a bad day, a problem of inaccuracy in their expectation, a problem between what was

Figure 4.1

Asthma Bad Day Expectations and Outcomes

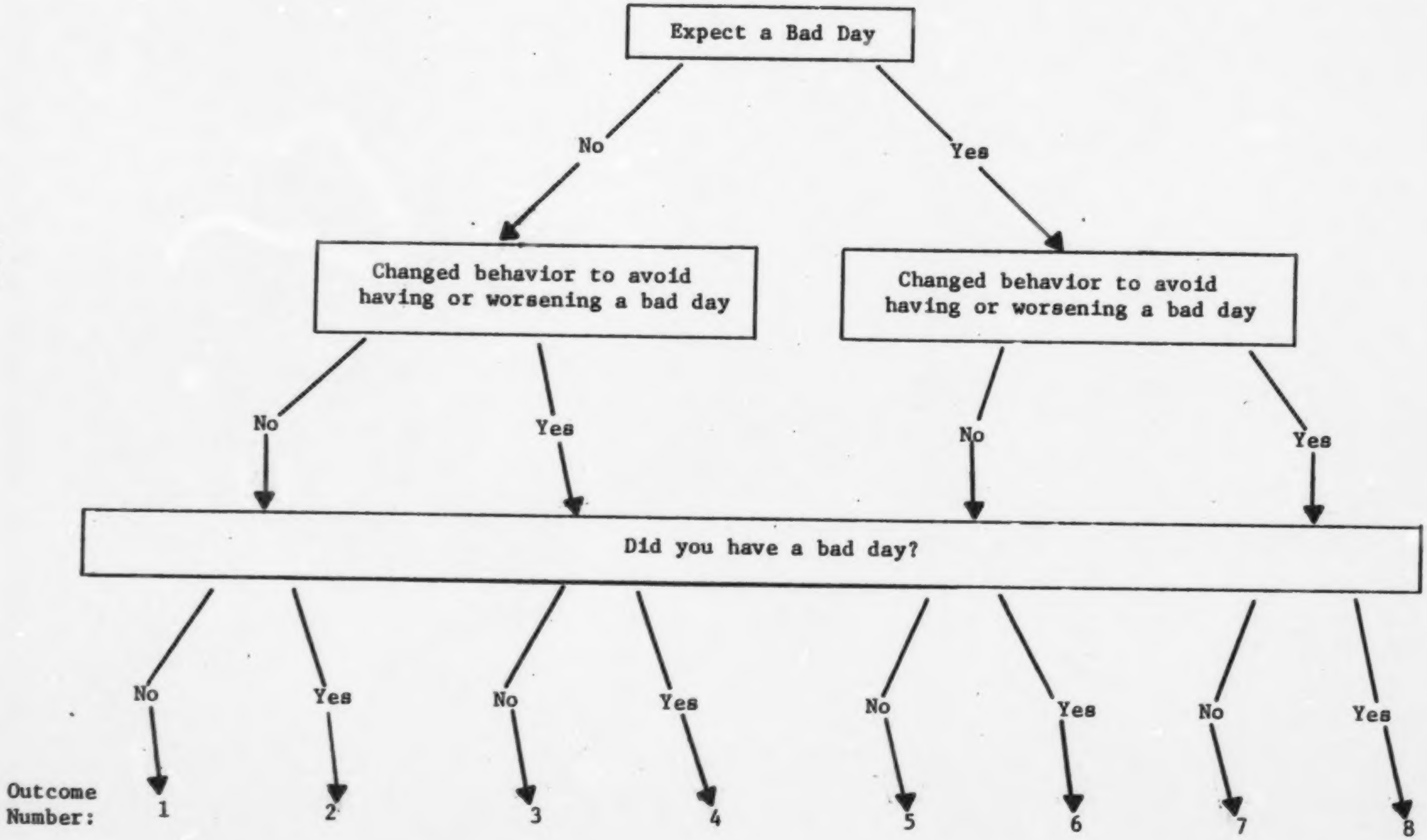
Expect a Bad Day
No
Yes
Changed behavior to avoid having or worsening a bad day
Changed behavior to avoid having or worsening a bad day
No
Yes
No
Yes
Did you have a bad day?
No
Yes
No
Yes
No
Yes
No
Yes
Outcome Number:
1
2
3
4
5
6
7
8

Table 4.5

Asthma Bad Day Expectations and Outcomes
(Percentage of Observations)

Outcome*	(1) Full Sample Of All Days	(2) Sample of Days When Air Pollution Is Not Checked	(3) Sample Days When Air Pollution Is Checked
1	50.4	54.4	30.1
2	9.1	9.5	6.8
3	5.1	4.8	6.8
4	2.1	1.4	5.8
5	11.1	9.8	17.8
6	5.7	5.5	6.8
7	8.0	6.4	16.1
8	8.5	8.3	9.6

* Outcomes defined in Figure 4.1

thought of as a bad day by the respondent when filling out the diary and the cut-off value for good days given at the first meeting, or the results of changes in expectations as the day progressed, or that their expectations of a bad day were not particularly strong.

If individuals change their behavior to avoid having or worsening their asthma symptoms this should be reflected in changes in the average hours spent in different activities (except in the previously noted case of timing and location shifts). A summary of average hours spent in different activities by outcome group is found in Table 4.6. The numbers are consistent with the hypothesis that work loss occurs when trying to avoid having a bad day (outcome 3 and 7) and is even greater when a bad day ends up occurring anyway (outcomes 4 and 8) as individuals respond to the bad day and perhaps attempt to prevent it from being worse. As expected, active outdoor leisure is generally lower for outcomes related to avoiding having or worsening bad asthma days (i.e., outcomes 3, 4, 7, 8, although the differences are modest). In some cases there seems to be a shift from active leisure and work into indoor leisure and chores.

The activity patterns shown in Table 4.6 are generally weak in demonstrating shifts in behavior because of their aggregated nature. Individuals may alter their behavior in different ways to avoid or respond to bad asthma days depending upon the perceived aggravating factors. Behavioral changes related to air pollution as a perceived aggravating factor are therefore addressed separately in the next section.

4.1.4 Air Pollution and Daily Schedule

Perceptions that air pollution might aggravate asthma may cause asthmatics to take averting or responsive actions in terms of altering their daily schedule in order to minimize the impacts. For example, one might spend more time indoors.[2] The reduced sample of only those 32 individuals who on one or more days checked air pollution was used to examine this hypothesis. To focus upon air pollution effects and reduce possible confounding factors, the sample was further reduced to include only those observations where air pollution was checked and the individual expected a bad day or air pollution

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[2] According to Yocum (182, pg. 511). "In summary, one can say with assurance that indoor concentrations of O_3 will almost invariably be significantly less than those outdoors, and that indoor environments will be an effective refuge from outdoor exposures to O_3." Spengler, et al. (1983) also suggest that indoor concentrations of organisms and micro-organisms are less than outdoors and that indoor levels of allergens, aerosols and smokes are much less than outdoors.

Table 4.6
Average Hours in Different Activities by Outcome

	Average Hours*							
Outcome	WKLOSS	CI	CO	ACIN	ACOUT	ININ	INOUT	NOBS
1	0	2.1	1.0	.75	1.0	4.0	.7	1896
2	0	2.3	.5	1.0	1.3	4.6	1.0	161
3	.7	3.6	1.5	1.0	.5	3.8	.8	90
4	1.8	3.2	2.1	1.0	.5	4.3	.9	37
5	0	2.0	.7	1.0	1.0	4.0	.7	198
6	0	1.8	1.0	.7	.6	4.0	1.1	102
7	1.4	2.7	1.3	.9	.9	4.2	1.3	142
8	2.28	2.3	.8	.5	.5	5.0	.9	151

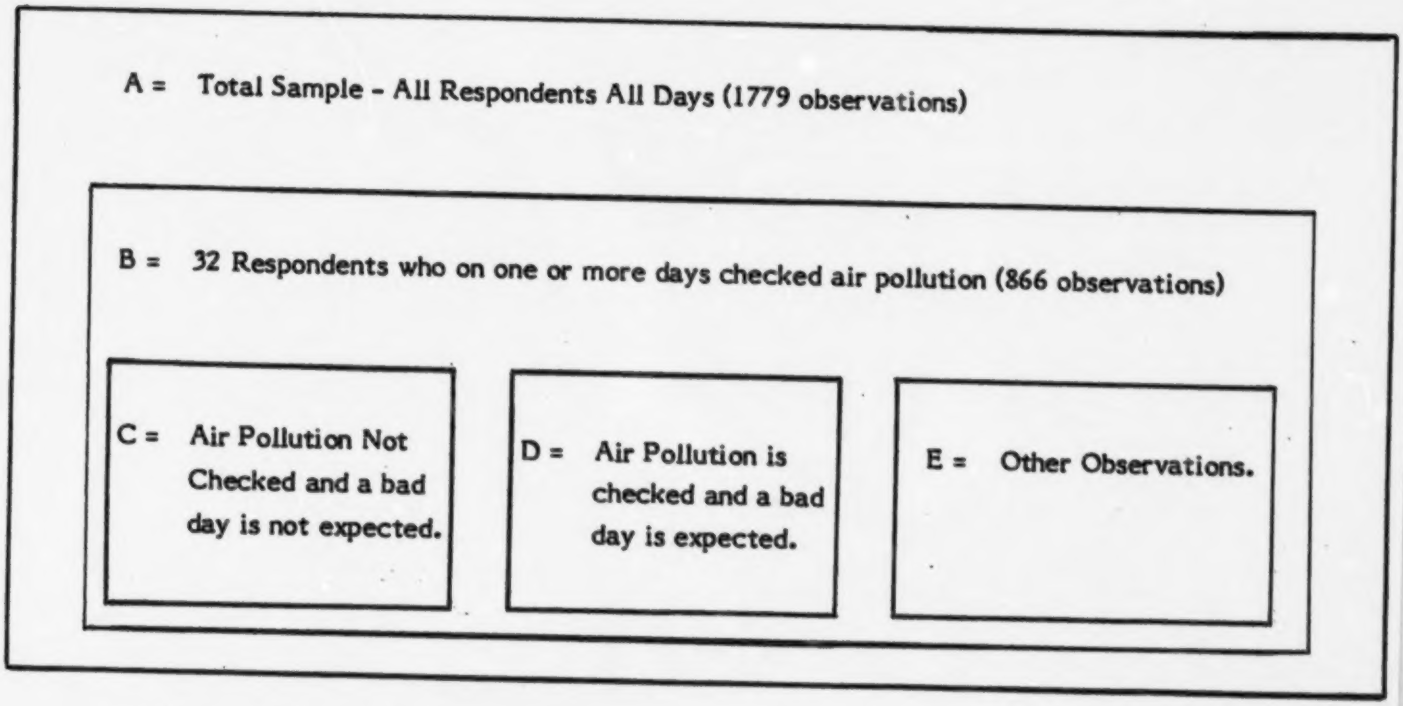
Sample: All observations.

Outcomes defined in Figure 4.1

See Table 4.4 for variable definitions.

Figure 4.2

Sample Used for Regressions on Daily Schedule



A = Total Sample - All Respondents All Days (1779 observations)

B = 32 Respondents who on one or more days checked air pollution (866 observations)

C = Air Pollution Not Checked and a bad day is not expected.

D = Air Pollution is checked and a bad day is expected.

E = Other Observations.

A = Universe of Observations

B = Subset of A = C + D + E

Maximum Sample for Regressions in Tables 4.7 and 4.8 = C + D (515 Observations)

Table 4.7
Response to Perceptions That Air Pollution May Aggravate Asthma and Cause A Bad Asthma Day
(t-ratios in parentheses)

Dependent Variable	Log (CI*)	Log (CO*)	Log (ACIN*)	Log (ACOUT*)	Log (ININ*)	Log (INOUT*)
Explanatory Variable						
Constant	-2.6 (-1.9)	1.02 (.51)	-.278 (-.16)	-5.8 (-2.9)	-4.2 (-3.33)	-1.6 (-.89)
EXPECT	-.20 (-1.93)	-.33 (-2.24)	-.186 (-1.46)	-.15 (-1.0)	-.145 (-1.59)	.224 (1.52)
Log (SEV)	.13 (1.20)	.21 (1.30)	-.05 (-.35)	.10 (.66)	.239 (2.44)	-.09 (-.60)
Log (AGE)	.18 (1.50)	-.28 (-1.48)	-.28 (-1.9)	-.05 (-.26)	.337 (3.08)	-.23 (-1.3)
Log (INC)	.09 (1.13)	-.17 (-1.46)	-.11 (1.1)	.46 (4.16)	.16 (2.13)	.28 (2.1)
SEX	.272 (2.81)	4.53 (3.45)	-.08 (-.71)	.33 (2.36)	.01 (.10)	-.07 (-.59)
F	3.49	9.14	2.22	4.17	2.38	2.12
R^2	.03	.09	.024	.046	.023	.024
NOBS	515	449	466	441	515	429

* The dependent variables are the ratio of daily hours for an individual divided by mean hours spent in a category over the study period for each individual respondent.

See Table 4.4 for variable definitions.

Sample: Respondents who on one or more days checked air pollution, observations where air pollution checked and EXPECT = 1, or air pollution not checked and EXPECT = 0. Respondents who always reported zero hours in a category were dropped from the analysis for that category.

Logs in base e.

Table 4.8

Work loss As Related to Perceptions That Air Pollution May Aggravate Asthma And Cause Bad Asthma Days

Dependent Variable Workloss	Coefficient (t-ratio)
Explanatory Variables	
Constant	-.187 (-.71)
EXPECT	.563 (5.66)*
SEV	.73 E-3 (1.04)
AGE	.28 E-3 (.09)
INC	-.47 E-6 (-.15)
SEX	.291 (2.96)*
Sample wide average work loss (hours)	.202
F	8.28
R^2	.075
NOBS	514

Sample: Respondents who on one or more days checked air pollution, observations where air pollution checked and EXPECT = 1, or air pollution not checked and EXPECT = 0.

* Significant at one percent level.

See Table 4.4 for variable definitions.

was not checked and the individual did not expect a bad day (see Figure 4.2). As a result the regressions reported in Tables 4.7 and 4.8 compare schedules on days when respondents expect to have a "good asthma day" and air pollution not to aggravate their asthma versus days when respondents expect to have a "bad asthma day" with air pollution as a contributing factor. Table 4.7 reports the results of analysis concerning the number of hours spent each day in various activity categories and Table 4.8 reports the results concerning hours taken off from the individual's usual daily schedule of work, school and chores due to asthma symptoms that day. Note that log-linear functional forms were selected for the former while a linear function was used for the latter due largely to the frequency of zero values for lost time from the usual work, school and chores schedule. These equations concern changes in schedules that may reflect mitigating behavior with respect to air pollution exposure and/or response to worsened asthma symptoms. These specifications are considered to be preliminary; potential refinements are discussed below.

In Tables 4.7 and 4.8, the coefficient on the explanatory variable "EXPECT" refers to the change in hours in an activity when a bad day is expected and air pollution is among the suspected factors. Generally, the coefficient is of the expected sign but of low statistical significance. Again, the severity coefficient is generally insignificant.

While recognizing their low statistical significance, these preliminary regressions indicate that when respondents expected a bad day and air pollution to be a contributing factor, they spend less time in chores (18 to 28 percent less), spend somewhat less time in active outdoor leisure and inactive indoor leisure (13 to 17 percent less), more work loss occurs (.56 hours) and more time is spent in inactive outdoor leisure and "non-activities" (25 percent or more increase). We include "non-activities", such as resting, sleep or doing nothing because when respondents expected a bad day they reported less total chores and activity time.

The analysis suggests that expectations of a bad asthma day, where air pollution is an expected causal factor, may lead to reduced activities that reduce air pollution exposure or other factors that will reduce aggravation of asthma symptoms. This will potentially flatten the estimated epidemiological relationship between asthma symptoms and ambient air pollution conditions.

Alternative "Full sample full model" log specifications were also examined. In these specifications all diary observations were included as were separate (0,1) variables for each factor in Question #1, a (0,1) variable for whether a bad day was expected, SEV and socio-economic variables listed in Table 4.8. The full sample full model results (not reported) for air pollution suggest that days when air pollution is checked are associated with less active outdoor leisure and chores, somewhat less active indoor leisure and somewhat more indoor chores being performed. Other results from the full sample full model are that those with higher asthma severity undertake larger adjustments in their day to day schedules. Day-to-day adjustments related to illness, tension and stress, weather, and a bad day yesterday were more pronounced than for air pollution for the sample group. Relatively low pollution levels during the study period could have contributed to this result. Illness was associated with a significant decrease in all activities except inactive indoor leisure, which significantly increased. Tension and stress were associated with less chores and inactive leisure and more active leisure. Concerns about weather were associated with significant substitutions from outdoor to indoor activities and an indication that one had a bad day yesterday results in substitutions from active to inactive activities.

The EXPECT coefficients in the above models may be imprecise as they still reflect two off-setting influences. When asthmatics expect a bad day they may, for example, reduce hours in active outdoor activities. On the other hand they may be more likely to expect a bad day with air pollution as a causal factor on days when more outside activities are planned. Similarly, when asthmatics expect a bad day they may alter their schedule to spend more hours indoors, but, they may also be less likely to expect a bad day from air pollution if their schedule plans are for more hours indoors. Confounding effects will reduce the ability of the simple model reported here to pick up and separate a priori and ex-post mitigating behavior. Refined simultaneous equation models, which could account for this simultaneity and for the constraint on maximum hours in a day, may improve the analysis.

Alternative analyses could include regressions on one individual at a time, although sample size and multicollinearity might be problematic. It might also be useful to examine the sample of days on which a bad asthma day was expected but not experienced, in order to measure the difference between mitigative activity changes to prevent an adverse effect from those changes in activities responding to a bad day and mitigating it from being worse. Finally, inclusion of lagged values of prior day expectations and ozone conditions may improve the model.

4.1.5 Conclusions

The daily diary results suggest that asthmatics, on average, have accurate perceptions about ambient air pollution conditions and expect their asthma to be aggravated when air pollution is high. When they expect their asthma to be aggravated by air pollution they are more likely to change their daily schedules in ways that can be expected to reduce pollution exposure and/or to reduce asthma symptoms. These changes seem to be in terms of less work/chores/school and substitution from active leisure. These substitutions can be expected to lead to less exposure to ambient pollution concentrations and as a result may bias estimated epidemiological relationships between pollutants and asthma severity toward zero.

This bias in the estimated epidemology relationship can be avoided through the use of personal exposure monitors (PEMs) (Ott et al. 1984, Johnson 1984) which account for actual exposures incurred. Nevertheless, the incidences measured in this way still fail to account for the economic value of mitigating behavior unless that behavior is also reported and valued.

Ozone levels were unusually low in the study area during the study period. The frequency and magnitude of behavioral adjustments could be expected to be even larger earlier in the season, thereby increasing the need to account for such behavior.

A final conclusion is that the existence of averting behavior on days when responsdents expect a bad asthma day and air pollution to be an aggravating factor suggest that there may be potential benefits of increased information on air pollution conditions. Such information may improve perceptions and assist in altering behavior to reduce adverse symptoms. To the degree that the cost of information and averting symptoms is less than the damages of incurring symptoms, a policy of information provision may be more effective than marginal reductions in ambient ozone concentrations.

4.2 GENERAL QUESTIONNAIRE RESULTS

The results and analysis of the general questionnaire are presented following the order of the questionnaire. Means and frequencies of responses are shown on the sample questionnaire in the Appendix. Variable names are defined in Table 4.4 in the preceding section. To highlight the consistency of the results across sections of the questionnaire, results of some earlier questions are compared to full sample results on the rankings and tax bid questions. This section concludes with a discussion of what these results imply about the relationship between COI and WTP estimates for asthmatics and with a discussion of methodological findings.

4.2.1 Medical Expenditures

Expenditure data by the survey respondents were collected on medical supplies, equipment and special treatment programs. These data were separated into fixed and variable costs, as defined in Table 4.9b, and adjusted by the number of asthmatics in the household. Information on doctor and hospital visits was also obtained from the respondents and from the UCLA data files.[3] Typical costs for different types of visits were calculated based upon an informal survey of costs for different services and treatments typically provided to asthmatics for emergency room, in-patient care, intensive care, and doctor's office visits at six hospitals in the Los Angeles and Glendora area. Researchers/physicians at the UCLA School of Medicine also reviewed the estimates for reasonableness and assisted in refining cost estimates of doctor office visits. These averages are reported in Table 4.9A.

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[3] There may be a slight upward bias in the variable medical cost estimates. Costs for doctor office visits for routine shots and medicines were included under medicines in the ERC general questionnaire survey procedure. Frequency of doctors' visits for other purposes was collected on UCLA questionnaires, although it appears some respondents included all office visits in their response leading to a double counting in our estimates. Further error was incurred here as the UCLA visits to doctors and hospitals were for the year ending nine months prior to this survey. Where possible, the UCLA data were updated by the current survey. A superior approach would have been to ask the total number of visits in the last year and then expenditure information for the last visit.

Table 4.9

Average Medical Costs

A. Average Costs Per Doctor and Hospital Visit For Treatment of Asthma Related Illnesses Based upon 1983 Six Hospital Survey

Category	Cost
Average In-patient Semi-private (Room + treatment + medicines + misc.)	$335/day
Average In-patient Intensive Care (Room + treatment + medicine + misc.)	$720/day
Emergency Room Visit (Room + treatment)	$120/visit
In-Hospital Doctor Visit	$30/day
Doctor Office Visit (Doctor office visits for regular shots and treatment, which do not entail a doctor visit are much less and are included in medicines under variable costs)	$35/visit after 1st visit*

B. Average Costs per Year for 82 Asthmatics in Glendora, California

	Household Total	For This Asthmatic
Total Fixed Cost Expenses	$713	$573
Total Variable Expenses/Year	528	435
Household Paid Fixed Cost Expenses	619	486
Household Paid Variable Cost Expenses/Year	268	208
Insurance Paid Fixed Cost Expenses	94	87
Insurance Paid Variable Cost Expenses/Year	260	227

Fixed cost expenses refer to one-time goods such as Intermittent Positive Pressure Breathing Machines.

Variable costs refer to expenses repeatedly incurred such as for medicines or doctors visits.

Insurance includes government programs.

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* First visits entail a full work up and are much more expensive. As all patients have been asthmatics for a number of years, first visit costs were not included in average medical cost estimates.

Average fixed and variable costs paid by the household and in total are reported in Table 4.9B. The difference between household paid and total expenditures is insurance payments. To simplify the respondents' recall requirements, they were asked only if the household or insurance paid for most of an expenditure, and a flat 80 percent coverage for all items without deductible was assumed if insurance benefits were indicated. This simplification increases measurement error in the medical cost estimates. The difference between the "Total" and "For This Asthmatic" columns accounts for households with more than one asthmatic. For these cases, total expenditures were adjusted to the respondents' share based upon their proportion of the household's asthma, as derived from Questions 1 and 2.

Both fixed and variable costs were found to be positively correlated with asthma severity. The variable medical costs reported here are three to five times larger than those estimated for asthmatics by Willett (1980, reviewed in Chapter 3). This reflects the fact that Willett only considered doctor visits, and that Willett's sample may reflect "healthier" asthmatics (see page 2-12).

Regressions on Variable Medical Costs

Estimated variable medical costs paid by the household and attributed to the respondent, including medications, treatments, doctors and hospitals, were regressed against severity (SEV) and selected socioeconomic variables (Table 4.10). Log specifications were superior to linear specifications with 70 percent higher F-statistics and R^2s. Significant in the regression results is that the elasticity of variable medical costs with respect to severity is just less than one, indicating that variable costs increase just less than proportionally to severity. Females were likely to report higher expenses than males. A variable for whether or not the respondent had insurance was never significant when included and had minimal effect on the other coefficients.

Table 4.10

Variable Medical Costs as a Function of Asthma Severity

Dependent Variable: Log of variable medical costs paid by the household = LOG (MEDVHH):

Explanatory Variable	Coefficient	t-ratio
Constant	-1.13	-.49
Log (SEV)	.92	2.4
Log (INC)	-.105	-.47
Log (RTFM)	.45	1.06
ADULT	-.51	-1.33
SEX	.90	2.86
F	4.73	
R^2	.24	
NOBS	82	

Sample: Full General Questionnaire Sample

Logs in Base e.

See Table 4.4 (page 4-6) for variable definitions.

Insurance

Thirteen percent (11) of the respondents held no medical insurance. Five percent (4) indicated asthma was in part the reason they had no medical insurance. Average annual variable medical costs paid by the household for this group of eleven individuals are $374, only 14 percent less than the average annual total variable expenses sample wide, yet double the average annual variable expenses paid by the household for those with insurance ($182). Other statistics on this subsample are reported in Table 4.20 below.

While it appears nearly all asthmatics can find insurance, an informal telephone survey of insurance agents found that asthma would normally be treated as a pre-existing condition, which would usually mean a six months treatment—free period or one year of continuous coverage would be required before asthma-related expenses would be covered, and they would likely receive a medical rating that would require either higher premiums or higher deductibles.

4.2.2 Work and School

Many economic assessments of health impacts related to changes in air quality focus upon short run impacts while ignoring long run impacts. For example, work loss days are often correlated with air pollution levels and valued at the average wage rate. However, the long-term effects of the air pollution-induced illness (or illness aggravation) upon employment status and wage rates often are ignored. These sections of the questionnaire focused primarily upon identifying whether these long terms effects are of importance.

Seven adult respondents felt their asthma affected their job status in terms of whether they were employed full-time or not (three were employed part-time and four not at all). Table 4.11 highlights selected responses for these seven individuals. First it is notable that their average severity is statistically significantly higher than the population average at the 10 percent one-tailed significance level using a t-test. Their average income is two-thirds that of the remaining 75 respondents and their average tax bid (a bid to reduce asthma severity by half, see Section 4.2.6) is also substantially less, perhaps reflecting an income constraint. Also important in terms of consistency of the responses throughout the survey instrument, these individuals ranked asthma effects on work as significantly more important than did the remainder of the sample (see Section 4.2.5).

Table 4.11

Comparison of Respondents Whose Job Status is Affected by Asthma With the Full Sample

ROW A = Respondents who are unemployed or employed part-time due to their asthma.

ROW B = All Respondents including those in Row A.

		Average Values for:					
Row	No. of Respondents	SEV	GDAY	NBAD	INC	WORK RANK	TAX BID
A	7	206	3.14	65.5	$21,780	2.1	$320
B	82	172	2.74	38.0	$31,707	3.79	$584

See Table 4.4 for variable definitions.

Of the 47 respondents employed full or part-time, 20 felt their choice of job was affected by their asthma, with most taking a less stressful job so as not to aggravate their asthma. Twelve respondents felt their asthma affected their income. Including the four respondents unemployed due to asthma, income was affected for 25 percent of the population. These respondents had higher asthma severity than the rest of the sample (a simple correlation between severity and whether the respondent felt asthma affected their job choice was positive and significant at the 5 percent level).

Of the 47 employed respondents, 19 (40 percent) felt their asthma could be better under different working conditions, but when these 19 were asked the maximum pay cut they would be willing to accept for a better work environment that would reduce their bad asthma days in half, only five gave non-zero answers. The majority of those who gave zero responses indicated that reduction in asthma would not be worth a pay cut or that they couldn't get by with less pay (Question 13b answers a and b).

An important finding is that all 14 $0.00 bidders to the pay cut question provided a non-zero response to the tax bid scenario for the same reduction in asthma reflecting that the question format is of importance to the WTP estimation process. The average income and severity for this group were very close to the sample averages. The average tax bid for these respondents of $739 was much higher than for the sample as a whole.

For those who gave non-zero responses to the wage WTP, the average Tax bid ($925) and income ($51,250) were significantly higher than for the remainder of the population. However, the average wage cut of $2.50/hour that would be accepted by this group, evaluated at 2080 work hours per year, results in an income reduction of $5,200 per year. Even adjusting for marginal tax effects, which could effectively result in a net WTP from disposable income to the respondents of only 50-60 percent of the wage WTP, the net annual value would still be double their tax bids for the same reduction in asthma. If all non-zero and zero bids are included, the average wage bid per year is $1368. If tax effects were to result in a 40 percent reduction, the net WTP from the wage bill is nearly identical to the tax bid WTP for this subsample.

The sample size difficulties and questions surrounding the wage bid scenario responses (discussed here and in Chapter 3) lead to the conclusion that it is probably not as useful a vehicle for valuing these types of health effects as the tax approach used later and little further analysis is warranted. One reassuring finding, however, is that the individuals who gave zero wage bids later ranked work loss slightly less important than the sample average (3.93 vs. 3.8) while the five non-zero wage bidders ranked work loss more important than the sample average (3.4 vs. 3.8).

All but one of the employed respondents felt that different working conditions could worsen their asthma. The question relating to pay increases for a job that would result in twice as many bad asthma days yielded amounts substantially larger than for the wage WTP. However, nearly half of the respondents were unwilling to accept the proposed increase in asthma symptoms, regardless of possible pay increases; although, this is comparable to the zero bid/refusal bid rate on the wage WTP question. For this reason and the small sample size, further analysis of the results of this question also seems unwarranted.

Turning to students, nearly two of every three felt their asthma affected their performance in school. Sixty-three percent of all students felt it affected their extracurricular activities and 40 percent of all students felt it affected their grades.

In summary, asthma appears to affect long term earnings potential. Simple correlation analysis shows that these effects are more likely to occur as asthma severity increases. If air pollution aggravates asthma severity, as is presumed, this will affect both day-to-day work behavior and long term earnings potential. Therefore, valuing only day-to-day impacts will understate changes in income related to changes in asthma conditions as air pollution changes.

4.2.3 Non-Paid Chores and Leisure

Eighty percent of the adult asthmatics felt that their asthma affected their ability to perform chores that they routinely do, but do not get paid for. Nineteen percent (10 respondents) hired individuals on a regular basis to perform chores, which they would not do if their asthma were less severe. These individuals spent an average $1,478 per year for these services.[4] Not all of these costs can be attributable to asthma as individuals will also derive benefits from not performing these chores even in the absence of asthma. With this in mind, it is still interesting to note the substantial size of these costs paid by the household. These individuals also had higher average severity (SEV = 197) relative to the remainder of the sample (SEV = 172) and an average income 20 percent higher than the remainder of the sample. A simple log linear relationship between the dollar costs of chores hired and severity for these individuals finds a statistically significant elasticity of .88, i.e., a 10 percent increase in severity results in a 8.8 percent increase in the costs of chores hired out in part due to asthma. These individuals also later ranked reducing activity affects from asthma to be much more important (average score = 1.8) relative to the remainder of the sample (average score 3.0).

Asthma affects leisure activities for nearly 75 percent of the respondents.[5] The respondents indicated that most often they change their activities or spend less time in leisure activities while occasionally doing the same activities at a different time of day. These results are consistent with the diary results, where chores and active leisure decreased, although by small amounts, on bad asthma days (Table 4.6). The results, especially with regard to chores, suggest it may be appropriate to assign substantial values to restricted activity days.

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[4] The cost of these services (identified on the respondents' survey form) were estimated using approximate market values. It is interesting to note that the sum of these costs for these ten individuals nearly equals the sum of household paid variable medical costs for the entire sample.

[5] The interviewer indicated the respondents seemed to be answering this question in terms of day-to-day short run changes and effects rather than for long run behavioral changes or health effects.

4.2.4 Residential Location

Populations who are sensitive to air pollutants may migrate to "cleaner" areas to reduce their asthma symptoms. Evidence of this comes from Ridker (1967) who indicated that of 10,000 patients advised by their physicians to leave the polluted Los Angeles area, at least one fourth acted on this advice within one year.

Most of the sample (83 percent) believe their asthma is affected by where they live. Of this 83 percent, three of five have considered moving from Glendora to reduce their exposure to agents that worsen their asthma, with air pollution being checked more than twice as often as any other agent as a reason to consider moving. Forty percent of those who felt location affected their asthma indicated they would move to another community in the greater Los Angeles area if they thought they would have half as many bad asthma days, and 60 percent would move if this would result in almost no bad asthma days. Each of two reasons were cited by 80 percent of those who said they would not move; their job was here and they didn't believe there was anywhere in the Los Angeles area where their asthma would be that much better. This latter response is best interpreted as a rejection of the scenario and suggests that if an acceptable scenario had been defined, the probability of moving would have been even higher.

Moving represents a substantial WTP for the household in terms of out-of-pocket costs, job and possibly income changes and social disruption for the family. Nevertheless a substantial portion of the respondents indicated they would move if they believed it would substantially improve their asthma. Based upon this evidence, and that of Ridker, it is likely that many asthmatics and other pollution-sensitive populations already have moved from the Los Angeles area, incurring a substantial cost in order to reduce their exposure to factors that may aggravate their health. One means of analyzing this behavior and the implied WTPs would be through a mail survey to the UCLA CORD population (see Chapter 2). UCLA has tracked, interviewed, and tested the health of these individuals over a number of years, keeping track of those who have moved out of the area. It is possible that the WTP to reduce asthma for those who have moved may be different (probably higher) than for those who have stayed in the Glendora area such that the WTP estimates presented in later sections of this report are biased downward.[6] Those who have moved might also represent a subsample who are more sensitive to the effects of air pollution indicating the epidemiology dose response functions for those who have stayed may underestimate responses for asthmatics as a group.

4.2.5 Rankings

Question 29 asked respondents to rank, in descending order of importance, five benefits they might receive from reduced asthma. This question was a final step in preparing respondents for the total willingness to pay question and, in combination with estimated medical costs, provides a consistency check on the WTP responses. The rankings are summarized in Table 4.12(a). Assigning values of one for first rank to five for fifth rank, and six if not ranked, yields the overall mean ranking.[7]

Part (b) of Table 4.12 presents t-test results of the hypothesis that the mean scores are identical. The t-tests reject the hypothesis that the mean scores are identical except for medical costs and work loss.

Respondents on average ranked 3.65 of the five items as having some importance. Discomfort (based upon respondent feedback, "pain and suffering" was reworded in the interview as "discomfort") and asthma effects on activities were clearly ranked above cost of illness measures of medical costs and work loss, which were ranked very closely to each other.

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[6] The average tax bid to reduce asthma for those who indicated they would move if asthma were reduced by half was nearly 50 percent higher than for the remainder of the sample.

[7] Unranked items were assigned a value of 6 because they were of no importance or unranked and therefore should have a value greater than or equal to 5, for being ranked fifth.

Table 4.12

Results of the Ranking

a. Rankings

Category	Overall Rank	Mean Score	SE of the Mean*	# times Ranked					# times not Ranked (= 6)
				1st	2nd	3rd	4th	5th	
Discomfort	1	2.16	.16	40	19	11	1	4	7
Activities Effects	2	2.89	.18	22	20	12	13	3	12
Medical Costs	3 tie	3.63	.20	12	14	19	8	5	24
Work Loss	3 tie	3.79	.20	7	20	14	11	2	28
Residential Choice	5	4.88	.15	1	6	9	10	16	40

b. t-ratios on pairwise comparisons of Average Scores**

	Discomfort	Activities	Med. Costs	Work Loss
Discomfort	—			
Activities	3.0	—		
Medical Costs	5.7	2.7	—	
Work Loss	6.4	4.5	.6	—
Residential Choice	12.4	8.5	5.0	4.4

Table 4.12

Results of the Ranking

(continued)

c. Selected Pairwise Comparisons.

Comparison***	No. Observation With			t-ratios****
	Value = 1	Value = 0	Both Not Ranked	
P(DA)	48	34	—	1.6
P(DW)	62	15	5	6.8
P(DM)	62	17	3	6.2
P(MW)	37	35	10	.2
P(AW)	49	27	6	2.6
P(AM)	45	33	4	1.4

* SE = Standard error of the mean score

** t-ratios of hypothesis that the mean ranks are equal

*** P(XY) = Probability that X is ranked more important than Y

D = Discomfort

A = Activities

M = Medical Costs

W = Work

**** t-ratios of null hypothesis that p = .5 (or that the categories are an average ranked equal)

The low ranking for the residential flexibility should be cautiously interpreted because it is based upon the responses of a group of asthmatics who live in a very high air pollution area. They have not moved in order to reduce their exposure to air pollution, which may aggravate their asthma. This may reflect lower sensitivity to air pollution by these individuals, so they may not be representative of other asthmatics in this regard.

The rankings were further analyzed using a logit approach where, for example, P(DA) is the probability that asthma effects upon discomfort are ranked more important than activities and so forth. For each individual, P(DA) = 1 if discomfort is ranked more important than activities and zero otherwise. If both items were not ranked, the observation was deleted. The results, reported in Table 4.12(c) generally substantiate those reported in Table 4.12b, but are less conclusive about the significance of the differences in the rankings. The differences in the approaches is that 4.12b is based upon a cardinal ranking and value assignment, while the logit results examine the data using an ordinal approach.

Simple logit regressions on the pairwise ranking comparisons were also examined with explanatory variables of severity and variable medical costs in all equations and selected other variables as applicable to each comparison. Generally, these linear logits showed, in terms of the statistical significance of the likelihood ratio test, little promise in explaining the rankings. One of the few promising logits, comparing the ranking of medical costs and work loss, is reported in Table 4.13. The results suggest that medical costs will be ranked higher than work loss as medical costs increase, but that work loss will be ranked higher with higher asthma severity or if the respondent feels their asthma affects job choice or school performance. Some of these findings are, however, conditional upon coefficients with low statisticial significance.

The likelihood ratio tests for the other pairwise comparison logits are significant at very low levels or not at all, and the asymptotic t-ratios of the severity coefficient generally range from .7 to 1.5. Specification testing, especially nonlinear forms, may yield improved results and should be considered as a means to more accurately estimate the logit relationship.

Table 4.13

Logit Regression Comparing the Rankings of Medical Costs and Work Loss

Dependent variable: P(MW)

Explanatory Variable	Coefficient	Asymptotic t-ratios
SEV	-.35	-1.22
JC	-2.08	-2.6
SCHOOL	-.88	-1.3
INSURE	-.008	-.02
MEDVHH	.64	2.7
CONSTANT	.333	.27
NOBS	72	
Likelihood Ratio test	15.9	with 5 degrees of freedom

P(MW) = 1 if medical costs ranked higher than work loss

= 0 if medical costs ranked lower than work loss

See Table 4.4 for variable definitions.

A linear discriminant analysis of the ranking data was also conducted by assuming that the population consists of subpopulations corresponding to different rankings of the data. The initial analysis defined five subpopulations depending upon which damage category was ranked first. The goal of statistical analysis of the data then is to be able to distinguish or discriminate among the five distinct distributions of the vector of characteristics that describe individuals. That is, the characteristics of individuals are assumed to come from one of five multinomial distributions. Discriminate analysis determines the importance of the characteristics (age, income, education, etc.) in differentiating the distributions. The products of discriminate analysis are two: (1) an analysis of the importance of these characteristics, and (2) the ability to predict preference of a particular category for an outside-of-sample individual or a hypothetical individual with a certain set of traits. This methodology has the advantage over pairwise logit or probit, for example, of treating the five categories in a unified manner. Thus problems of sample selectivity bias are avoided. This kind of parameter bias (first explicated in the female labor supply literature by Gronau 1974, and Heckman 1976) occurs when the sample is segregated (or selected) on the basis of the dependent variable. This would occur if only those respondents choosing categories 1 and 2, for example, were analyzed.

Discriminant analysis is interpreted as a classification procedure for individuals, rather than as a behavioral model of choice. It has the disadvantage of assuming that all variables are normally distributed, which cannot be the case given our data. Conventional lore (see Klecka 1980) implies that results are robust to this kind of misspecification. It has the further disadvantage that a significant ability to discriminate is often coupled with considerable difficulty in interpretation. This was true in our data, as explained below.

Linear discriminate functions were defined including several characteristics of the respondents as explanatory variables. With the analysis restricted to the single, most significant discriminant function, approximately 51 percent of the variation in the data was accounted for. An examination of the standardized canonical discriminant function coefficients revealed that the dummy variable for age (1 if adult, 0 if minor) had by far the most discriminating power, with age (in years) second. Prediction power is low, however, with only approximately 20 percent of the cases predicted correctly. Since there are five groups, this is no improvement over random assignment to groups.

When the analysis is expanded to allow for three discriminant functions, approximately 95 percent of the variation in the data is explained. In the second function the respondents' own evaluations of their degree of asthma severity had the most discriminating power. Now about 40 percent of the cases are correctly assigned to groups. The fifth category, "less pain and suffering," was the most difficult to predict. Almost one half of the respondents picked this category first, yet only seven are predicted to be in this category. Of the 42 cases in other categories, 26 percent are correctly placed. Due to their limited explanation power, these results are not reported in detail here.

The distribution of category choice and the category definitions suggest a simplification of the analysis. Only one of the 82 cases ranked the third category, "more location flexibility" first. Therefore that category (and observation) was eliminated. The first two categories, "lower medical expenditures" and "higher wages" were aggregated and labelled as "cost of illness", while the last two categories, "higher quality leisure time" and "less pain and suffering" were aggregated into a "quality of life" choice. Now family size and age of respondent emerge as the two most important characteristics. Three variables, income and two measures of asthma severity (self evaluation and the reported number of bad asthma days) comprise a second group of important predictors (see Table 4.14). Interestingly, the dummy variable for adult status loses much of its importance, while the remaining variable in the analysis, a dummy variable for health insurance coverage, had almost no discriminating power. Now slightly more than 60 percent of the cases were correctly placed (note that for two categories, 50 percent would be correctly placed by random assignment).

Overall, the ranking section seems to be well received by respondents and the rankings are, on an individual basis, very consistent with responses to other questionnaire sections.

4.2.6 Tax Bid Analyses

The tax bid question referred to a change that would result in a 50 percent reduction in "Bad Asthma Days". The question appeared generally to be well received with 69 non-zero responses, 12 zero responses and one refusal. Initially 11 of the 12 zero bids were identified as rejections of the format based upon responses to Question 30b. This resulted in a mean bid of $584 per year with a standard error of the mean of $112. Upon continued evaluation of the responses, discussed below (page 4-37 through 4-38), some zero observations were retained and a few non-zero bids deleted resulting in a mean bid for 65 observations of $401 per year with a standard error of the mean of $85.

Table 4-14

Standardized Discriminant Function Coefficients and Classification Results on Ranking Data

I. Cannonical Discriminant Function between Group 1 and Group 2 (see Section II for definitions.

Variable	Coefficient[1]
ADULT	-.40
FAMILY SIZE	.70
RTFM	-.51
INCOME	-.01
AGE	.66
NBAD[2]	.47

II. Predicted Group Membership

Group 1	Individuals who ranked a cost of illness category first (medical costs, work loss)
Group 2	Individuals who ranked a quality of life category first (discomfort, reduced activities)

	Group 1	Group 2
Actual number of observations	19	62
Predicted number in Group 1	13 (68.4%)	26 (41.9%)
Overall Prediction Power	60.5% of individuals were correctly classified.	

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[1] No statistical significance is assigned to individual coefficients. A (+) sign indicates increased probability of ranking a group 1 category first, a (-) sign indicates increased probability of ranking a Group 2 category first.

[2] Results with SEV instead of NBAD are similar but the overall percent of correct classification is reduced to 58 percent.

Sample Selection for Tax Bid Analyses

For subsequent tax bid analyses a number of the initial 82 observations were deleted to arrive at a sample that was felt to reflect actual bids rather than actual and rejection bids. The reasons for these deletions and the number of responses involved are summarized below. Bids were deleted if:

1. NBAD equaled 0, due to the respondent's selection of a maximum good day value that indicated there were no bad days to reduce (perhaps their asthma is in remission), and the tax bid was greater than or equal to $100/year. In this case the bid could not be to reduce NBAD, as we had measured it. (4 respondents)

2. NBAD was less than or equal to 3 (1/13 the sample average) and the tax bid was greater than or equal to $1000/year (more than twice the sample average). As with the respondents who fell in category #1, there were few bad days to reduce. It appears these respondents answered the tax bid question in terms of reducing overall severity rather than bad days. It may be the case that most respondents answered this way, but the difference between reducing overall severity and bad days becomes less significant as the number of bad days increase (see consistency checks below). (2 respondents)

3. The tax bid equaled zero, number of bad days exceeded 9, medical costs exceeded $150/year and were not ranked first, and a rejection response was given on the zero bid follow-up question (30b). It is likely many of these respondents simply rejected the tax bid question as unrealistic or in some way objectionable or less desirable than other approaches. (7 respondents)

4. Tax bids were less than $50, number of bad days was greater than 75 and the tax bid/medical cost/ranking consistency check would not work even using one-tenth of medical expenditures (see section on consistency checks). It appears these respondents were not willing to pay to reduce asthma through the vehicle provided. (2 respondents)

5. No tax bid response was provided. (1 respondent)

6. A tax bid of \$5000 was deleted for one respondent who reported household income of less than \$5000/year. (1 respondent)

In total 65 responses, including six zero bids, were retained for further tax bid analysis as not exhibiting substantial inconsistencies. The consistency checks for this group reveal that their responses are generally in keeping with other data provided in the questionnaire.

The average tax bid for this group was \$401 with a standard error of the mean equal to \$85. The mean estimated variable medical costs paid by the household was \$272 with a standard error of the mean equal to \$55.

Tax Bid Model

Tax bids were given for a 50 percent reduction in bad asthma days. The following model is posited:

$$\text{Tax Bid} = \alpha \ (\text{NBADR})^{B_1} (\text{GDAY})^{B_2} X^{B_3} \qquad (4.1)$$

$$\frac{\partial(\text{Tax Bid})}{\partial(\text{NBADR})} = \alpha \ B_1 \ (\text{NBADR})^{B_1 - 1} \ (\text{GDAY})^{B_2} X^{B_3} \qquad (4.2)$$

$$\frac{\partial^2(\text{Tax Bid})}{\partial(\text{NBADR})\,\partial(\text{GDAY})} = \alpha \ B_1 B_2 \ (\text{NBADR})^{B_1 - 1} (\text{GDAY})^{B_2 - 1} X^{B_3} \qquad (4.3)$$

where NBADR is the number of bad days reduced (= 1/2 NBAD), GDAY is the highest day rating on the 1 to 7 UCLA severity scale that the respondent still considered to be a good day, and X is other selected socioeconomic variables. α B_1, B_2, B_3 are coefficients. NBADR, GDAY and X all have values greater than 0.[8]

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[8] If NBADR = 0 or Tax Bid = 0, they were recoded to a value of .5 for use in the log model.

Assuming α is positive, (4.2) will be positive if B_1 is greater than zero and (4.3) will be positive if B_1 and B_2 are greater than zero.

Economic practice would normally assume that increases in good asthma days (365-NBAD) would result in utility increasing at a decreasing rate and, therefore, B_1 would be greater than zero and less than 1. GDAY is included because the NBAD value is contingent upon the respondents' selected GDAY value. For example, two identical individuals selecting different GDAY values would have different amounts of bad days. Similarly, one would expect the WTP for the same number of bad days reduced to increase as the severity of the associated bad day asthma symptoms increase, which is in part measured by the GDAY variable. These examples suggest that the change in WTP for a change in bad asthma days reduced is a multiplicative function of NBADR and GDAY. The model in equation 4.1 is one of many possible functions with this property and was selected for its simplicity.[9]

Table 4.15 presents the estimated regressions and predicted tax bid values for different combinations of NBADR and GDAY. The mean values of NBADR and GDAY are 19 and 2.74. The regression model supports the hypothesis of decreasing marginal utility for increasing reductions in bad asthma days (WTP increases at one-half the rate of the number of bad days reduced) and, as indicated by the GDAY coefficient, weakly supports the hypothesis that reductions in bad asthma days are valued more the greater the asthmatic's severity (see also Table 4.15(B)). The low statistical significance of the GDAY coefficient may reflect the fact that a linear index was used to define GDAY; although the growth in the intensity of effects from "no symptoms" to "moderate symptoms" may be nonlinear, and could be respecified as four zero-one variables as only four GDAY categories were ever selected on the seven point seventy scale (see page A-5). Coefficients on income, medical costs, and sex were not significant.

To examine the hypothesis that the bids actually reflected general reductions in severity rather than bad asthma days, the model was estimated with SEV, GDAY and NBADR included, and with SEV included but GDAY and NBADR excluded. Neither of these models performed better than the reported model and SEV was not statistically significant, al-

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[9] Ideally a model used for the tax bid analysis would be derived from the specification of a utility function model. Using several different utility models, tax bid specifications similar to Equation 4.1 can be derived.

Table 4.15

Tax Bid Regression and Predicted WTP Values for a 50 Percent Reduction in Bad Asthma Days

a. Regression Model

Dependent Variable Log (Tax Bid)

Explanatory Variable	Coefficients	t-ratio
Constant	.2834	.078
Log (NBADR)	.565	4.25
Log (GDAY)	.973	1.43
Log (MEDVHH)	-.0433	-.280
Log (INC)	.292	.896
SEX	-.416	-.899
F	5.276	
R^2	.3090	
NOBS	65	

b. Predicted WTP Values ($'s)

		No. of Bad Days Reduced			
GDAY		1	5	15	50
1	(no symptoms)	$22	$54	$101	$199
2	(very mild symptoms)	43	106	198	391
3	(mild symptoms)	64	158	294	580
4	(moderate symptoms)	84	209	389	767

Logs in base e

Variable names defined in Table 4.4

Predicted WTP values calculated for males at the sample means for income and variable medical costs.

though the coefficient was positive. We interpret this to suggest that respondents in the final sample were bidding for reduction in bad asthma days rather than for general reductions in asthma severity.

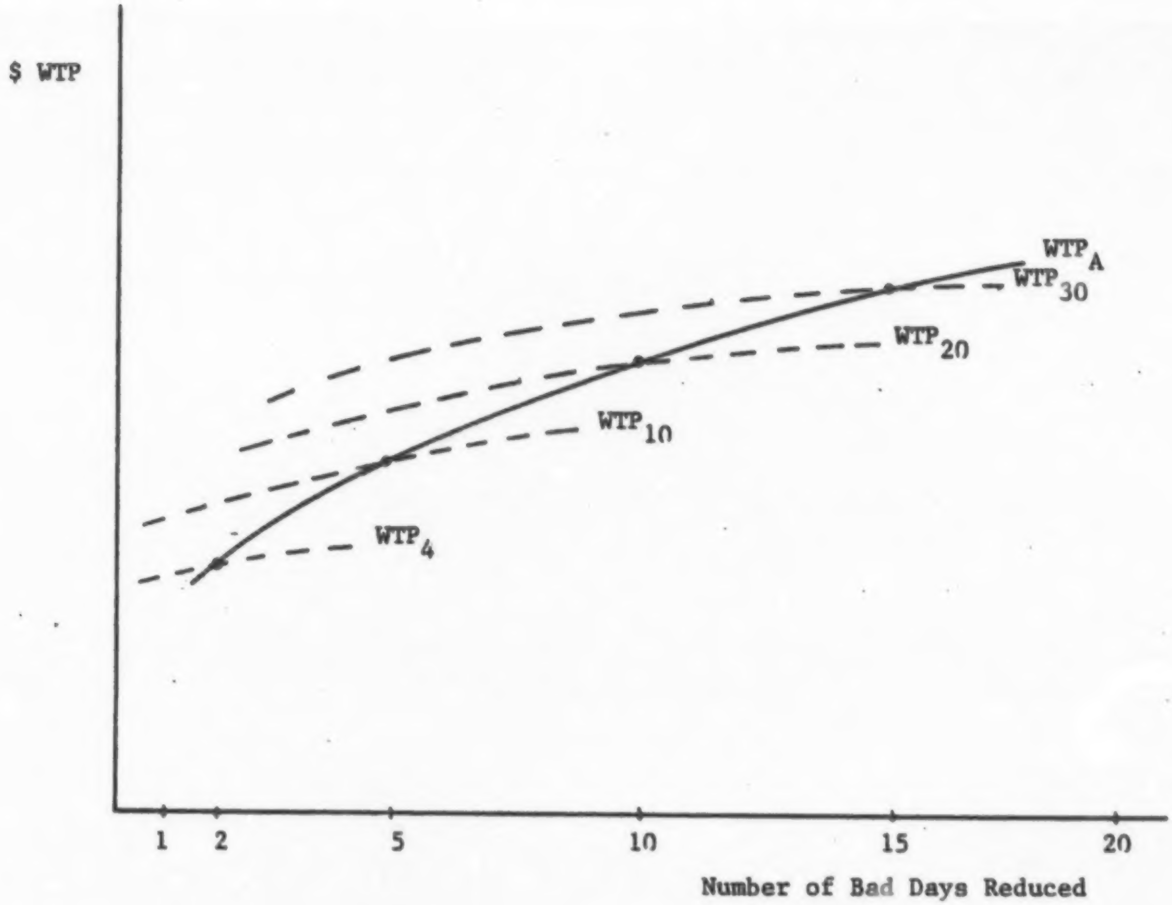
Care must be taken in interpreting the tax bid regression model results. The regression estimates a WTP curve for a 50 percent reduction in bad asthma days estimated across individuals with different asthma severity (or different levels of bad asthma days). As a result, the regression curve does not trace out an individual WTP curve, but a locus of points representing the WTP to reduce asthma by half for each NBAD level. For example, it traces out the WTP to reduce five days for individuals with ten total bad days, WTP to reduce ten bad days for individuals with twenty total bad days, and so forth. The WTP value to reduce five bad days, however, may be different for those individuals with ten rather than twenty total bad days. If WTP by an individual increases at a decreasing rate with the number of bad days reduced (i.e., with an increase in good days) and the WTP to reduce X bad days is the same for all individauls, regardless of the baseline total number of bad asthma days experienced, then the underlying WTP curves of different individuals all fall on the regression function. More likely, WTP to reduce X bad days (i.e., improve by X good days) increases with the baseline number of bad days experienced and the underlying individual WTP curves are flatter than the regression line as illustrated in Figure 4.3. It is important to note, however, that the shape of the underlying WTP curves cannot be determined from this data.

It is again worth noting that SEV was not statistically significant when included in the tax bid regression, although this may be the result of multicollinearity between SEV and the NBAD and GDAY variables. This suggests that WTP for a reduction in bad asthma days may be independent of the level of asthma severity (measured either by NBAD or SEV), and, therefore, WTP_A and the underlying WTP_i curves may be nearly identical.

Table 4.16 presents marginal WTP for the next bad day reduced and the average WTP per bad day reduced calculated from the estimated WTP_A regression curve. The reported marginal WTPs will overstate those values on the WTP_i curves if the situation as depicted in Figure 4.3 is correct.

Figure 4.3

Potential Relationships Between the Aggregate WTP Function and Individual WTP Functions



WTP_A = Estimated WTP function across respondents for a 50 percent reduction in NBAD

WTP_i = WTP function for an individual with NBAD = i. Sample Average = $401.

NBAD = Number of bad asthma days. Sample Average = 38.

Table 4.16

WTP Values for a Reduction in a Bad Asthma Day

a. Marginal Tax Bid for the Next Bad Asthma Day Reduced

GDAY		No. Bad Days Already Reduced (NBADR) 1	5	15	50
1	(no symptoms)	$17	$6	$4	$2
2	(very mild symptoms)	33	12	7	4
3	(mild symptoms)	49	18	11	7
4	(moderate symptoms)	64	24	15	9

b. Average Tax Bid per Bad Day Reduced

GDAY		No. Bad Days Reduced (NBADR) 1	5	15	50
1	(no symptoms)	$22	$11	$7	$4
2	(very mild symptoms)	43	21	13	8
3	(mild symptoms)	64	32	20	12
4	(moderate symptoms)	84	42	26	15

Average Values are predicted tax bids (Table 4.15(B)) divided by number of bad days reduced.

Marginal values calculated as the first derivative of the regression model.

The tax bid design and analysis could benefit from refinements. The design could benefit by having individuals bid on reductions in two or more levels of bad asthma days so as to allow the underlying individual WTP_i curves to be traced out and compared to the WTP_A curve. In the regression analysis, heteroskedasticity, introduced through the design of the tax bid payment card,[10] and measurement error due to differences in our measure of NBAD versus respondents' perceptions of NBAD, may also be affecting the precision of the estimates. Since the NBADR value was not presented to the respondents, there could be divergence between the calculated number and each respondent's perceived number. This measurement error is likely to increase with the number of bad days. The impact on the statistical significance of the findings due to these effects is unknown. Alternative function forms, with increased relationship to underlying utility theory and incorporating GDAY as a categorical variable could lead to improved estimates.

Tax Bid WTP Consistency Checks

A major issue in contingent valuation (CV) studies has been the credibility of the values received through hypothetical questions (Cummings et al., 1984). The survey instrument for the current study was designed specifically to examine the plausibility/consistency of the CV responses by examining zero and large bids, and by comparing the tax bid, medical costs, rankings and other responses. Of the 82 respondents, one refused to respond to the tax bid question and one gave a bid exceeding his stated income. These responses were deleted. Twelve zero responses were given. Based upon a typical zero bid follow-up question (see the Appendix), often used as a means to examine the validity of zero bids, eleven bids would have been deleted. However, in this survey, other data were available to check the plausibility of the zero bids, including an estimate of the annual number of bad asthma days for each individual. Five zero bids were subsequently interpreted as probably valid because the individual's asthma was such that he or she had zero or one bad day in the last year and very low medical costs. Therefore, reducing bad asthma days by half could approximately be valued at zero. The remaining seven zero bids were deleted, as indicated in the sample selection section above. One conclusion is that people who hold actual zero values for a proposed CV question may also reinforce their values by checking a response to the zero bid follow-up question that suggests a rejection of the CV question and which leads the analyst to delete more zero bids than is appropriate.

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[10] The intervals between dollar amounts listed on the payment card increase with increases in dollar amounts. As a result the measurement error associated with picking the listed WTP value closest to one "true" WTP value also increases with the WTP value.

All 68 remaining non-zero WTP responses were evaluated with the following consistency check.[11] It was first assumed that a 50 percent reduction in bad asthma days would yield a 46 percent reduction in variable medical costs (.92 from Table 4.10 times 50 percent reduction in asthma severity). WTP should therefore exceed .46 of the individual's variable medical costs. Further, if changes in medical costs are ranked third, for example, total WTP should exceed .46 of variable medical costs by at least a factor of three, if changes in each of the above ranked categories are valued at or more highly than changes in medical costs. If changes in medical costs are ranked fifth then total WTP should exceed .46 of variable medical costs by a factor of five or more and so forth.

One important limitation to the consistency check analysis is that while the individual may be attempting to give accurate and reasonable estimates for their medical costs and underlying values for changes in asthma, measurement error may result in failure of the consistency check.

Of the 68 individuals with responses analyzed with the consistency check, 37 provided medical cost, tax bids and rankings that were consistent with the above assumptions, and another 16 were consistent using a reduction in medical costs of 25 percent or allowing a 33 percent measurement error in either the tax bid or medical cost estimates.

This brings up a second important limitation in the consistency check. The WTP bids are based upon a 50 percent change in bad asthma days, while the estimated reduction in medical costs are based upon a 50 percent change in severity measured as the sum of monthly frequency times the intensity of asthma symptoms. For an individual with a large number of bad asthma days, a 50 percent reduction in bad asthma days and in overall asthma severity may be quite similar. The correlation between 50 percent changes in these measures is likely to lessen as the number of bad asthma days decreases. For this reason, the alternative of 25 percent of medical costs was used in the second application of the consistency check.[12] We view this as a weakness in our application, rather than the general design, of the consistency check procedure. Overall, over 73 percent of the WTP responses (including zero bids) could be evaluated as "probably reasonable" (37 plus 16 of the 68 bids evaluated with the consistency check plus 5 of the 12 zero bids).

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[11] Eighty-two respondents minus 1 rejection bid minus 1 bid exceeding income minus 12 zero bids evaluated in the previous paragraph left 68 responses to be evaluated with the consistency check.

Of the 15 non-zero WTP responses that either did not pass application of the consistency check or were viewed as of "uncertain quality," four observations were interpreted as likely to be "unreasonable." Two had bids exceeding $1,000 but NBAD equal to or less than three, and two had bids less than or equal to $50 but NBAD exceeding 75. In both cases, the bids were at least ten times larger or smaller than the person's variable medical costs. (These were the individuals identified in points 2 and 4, page 4-37, dealing with the tax bid regression sample selection.)

The consistency checks suggest the WTP responses are generally just large enough to be consistent with the ranking and medical cost data. However, the average WTP for the tax bid regression sample ($401), the average variable medical costs for this sample ($272) and the overall ranking of reduced medical costs as third behind discomfort and activity effects suggests that the responses are also small enough to be believable. The average WTP tax bid is consistent with the overall rankings (where medical costs and work loss are tied for third implying that total WTP must equal or exceed about four times reduced medical costs) only with a 32 percent reduction in variable medical costs sample wide for a 50 percent reduction in bad asthma days.

In summary, the use of consistency checks based upon other data generated in the questionnaires is a promising approach in CV instruments to determine "reasonable" and "unreasonable" responses. They also help to illustrate in an application such as this where the valuation issue is very familiar and important to respondents, most of the CV responses appear to be of reasonable quality.

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[12] In defense of the argument leading to the second application of the consistency check with 25 percent medical costs, the average number of bad asthma days was 54 for those passing the check with 46 percent of medical costs, 27 for those passing with 25 percent of medical costs and 10 for those where neither application of the consistency check worked. This included four individuals where the estimated NBAD equalled zero, but the tax bid exceeded $100 per year. Apparently these individuals were bidding upon overall asthma severity reductions. These individuals were deleted in the tax bid regression analysis. See point 1, page 4-37.

4.2.7 Implied Willingness to Pay Values

The rankings, total tax bid WTP values, and estimated medical costs were also used to attempt to derive implied WTP values for individual damage categories for each respondent. These implied WTP values were calculated to examine whether differences across individuals could be well explained, but are not central to the above CV analysis.

The process can be explained with the assistance of Table 4.17. In this example an individual had 46 percent of variable medical costs paid by the household equal to $50. The individual ranked reduced medical costs third and gave a tax bid WTP = $450. If changes in effects in those categories ranked less important are valued less, then their lower bound is zero and their upper bound cannot exceed $50 (although it could be less if there is insufficient residual after calculating minimum values for categories ranked higher than medical costs).

The maximum value for the category ranked second is determined as follows. The value assigned to the category ranked second cannot exceed the value assigned to the category ranked first. Therefore the upper bound on Rank 2 is the total ($450) minus the lower bounds on all categories ranked lower (minus $50 medical costs, minus $0, minus $0, which equals $400) divided by two. In this case the value assigned to Rank 1 and Rank 2 would both equal $200.

The lower bound on the second ranked category must be at least equal to $50, the implied reduction in medical costs. The upper bound for the first ranked category is the tax bid ($450) minus the lower bound on all other lower ranked categories (minus $50, minus $50, minus $0, minus $0), or $350. The upper bound on the first category ranked lower than medical costs is the total WTP minus the lower bound on all above ranked categories, including medical costs but cannot exceed medical costs. All subsequently lower ranked categories upper bound calculation proceeds in a similar fashion, with the residual of the WTP bid minus lower bounds on categories ranked higher than medical costs and minus estimated medical cost reductions. The residual is divided by the number of categories ranked below medical costs, but not below this category. The lower bound on the first ranked category equals the total ($450) minus the sum of upper bounds for medical costs and all lower ranked categories ($150) divided by the number of categories ranked higher than medical costs (2), in which case all higher ranked categories would have the same implied value.

Table 4.17

Example Calculation of Implicit WTP's

Total WTP = $450	Upper Bound	Lower Bound	Average
Rank 1	$350	$150	$250
Rank 2	200	50	125
.46 variable medical costs	50		50
Rank 4	50	0	25
Rank 5	50	0	25

Table 4.18

Implicit WTP Values for a 50 percent Reduction in Bad Asthma Days

	Mean Values (55 respondents)		
Variable	Mean	SE(X)	Definition (See text)
WTP1	$45.5	6.6	Implicit Medical Cost WTP
WTP2	$74.1	19.2	Implicit Work Loss WTP
WTP3	$40.4	11.0	Implicit Residential Choice WTP
WTP4	$154.0	56.9	Implicit Activities Effects WTP
WTP5	$163.2	32.4	Implicit Discomfort WTP
TAXBID	$443	$98.8	Total WTP

Once all upper and lower bounds are determined they are averaged to yield the calculated average implied WTP value for each category. These calculations were made for all respondents in the tax bid regression sample. As is apparent, the calculation process is not simplistic and will vary a great deal from case to case. At times a consistent allocation could not be made. For example, if reduced medical costs of $50 were ranked third, but total WTP equalled $100, the consistency check would fail and the implied WTP values could not be determined in a manner consistent with the WTP bid and rankings.

Forty-six percent of medical costs were used for the implicit medical cost WTP if a consistent allocation of the tax bid could be made; otherwise one fourth of medical costs were used. If even one fourth of medical costs would not yield a dollar allocation consistent with the rankings and total WTP, the observation was dropped for use in calculating implicit WTPs.[13] The averages of these implicit WTP estimates are provided in Table 4.18. This procedure results in implicit WTPs for work loss and medical costs that, combined, are just over one fourth of total WTP. It is noteworthy that the process had the secondary effect of depressing the implied medical cost WTP values due to their being calculated at either .46 or 1/4 of estimated actual costs. These never were allowed to vary upward, like values for categories ranked above medical costs. The procedure was not constrained such that the sum of the implied averages equalled the tax bid, as would be desirable in future applications.

Table 4.19 reports regression model results relating the implicit WTP's to severity measures and socioeconomic characteristics. The severity measures (NBADR, GDAY, SEV) generally contribute to the WTP2 and WTP3 regressions, but not to the WTP4 and WTP5 regressions. This may be because severity is less important, or because CHHIR (equals one if due to asthma some or all chores are performed by hired labor) and LA (equals one if asthma affects leisure activities) may be highly correlated with severity. Such multicollinearity would cause the significance of the severity coefficients to decline. In either event, these last two models have much lower statistical significance.

The work loss WTP model appears to work well and to suggest that the intensity of asthma, measured by SEV and GDAY, is more important than the frequency of asthma

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[13] As noted in the discussion on consistency checks, this does not necessarily invalidate the ranking or tax bid estimates, it simply suggests limitations in our design and implementation of the procedure. In many cases the procedure did not work for individuals who had very few bad asthma days, so that a tax bid much less than one-fourth of medical costs could be appropriate. Fifty-five respondents, including accepted zero bid responders, were retained in the analysis.

Table 4.19

Regressions with Implicit WTP Values
(t-ratios in parantheses)

Dependent Variable	Log (WTP2) (work loss)	Log (WTP3) (Residential)	Log (WTP4) (Activities)	Log (WTP5) (Discomfort)
Log (NBADR)	.188	.20	.12	.30
	(.133)	(1.51)	(.73)	(1.83)
Log (GDAY)	2.36	1.47	.62	-.02
	(3.16)	(2.1)	(.72)	(-.02)
Log (SEV)	1.62	1.59	-.56	1.00
	(2.37)	(2.5)	(-.71)	(1.2)
Log (AGE)				.04
				(.09)
Log (INC)			.06	.51
			(.16)	(1.2)
JC	1.25			
	(2.05)			
SCHOOL	-.26			
	(-.41)			
UNEMP	.575			
	(1.07)			
SEX	-.37	-.69	-.51	-1.1
	(-.84)	(-1.70)	(-1.0)	(-2.1)
ADULT		-.99		
		(-2.05)		
OWN/RENT		.52		
		(1.15)		
LIVE		.52		
		(.87)		
LA			1.69	1.41
			(2.8)	(2.4)
CHHIR			2.1	
			(2.1)	
NOBS	55	55	55	55
F	5.06	3.90	2.24	2.97
R^2	.43	.37	.25	.31

Variables defined in Tables 4.18 and 4.4.

symptoms, measured by NBADR. In fact only in the discomfort model (WTP5) does frequency appear to be potentially more important than intensity. Caution is merited in the model, due to the large errors inherent in the procedure used to calculate the implicit WTP, and in interpreting the coefficients on NBADR, GDAY, and SEV due to multicollinearity among the variables and the small sample size. The simple correlations between SEV and GDAY and between SEV and NBAD are .22 and .25.

4.2.8 Comparisons Between COI and WTP Measures of Value for Reducing Asthma Severity

One objective of this research was to compare the magnitude of WTP and COI measures of value for changes in illness using asthma as an example. This section provides that comparison from the perspective of an individual asthmatic and from the societal perspective based on the data obtained in this study. The WTP measure used for the comparisons is the total tax bid for a 50 percent reduction in bad asthma days. The COI measure is defined and discussed in the next section.

Defining a COI Measure of Value for Reduced Asthma

The most frequently used COI measure combines estimated changes in variable medical costs and work loss due to changes in illness. The COI measures used in the following comparisons are based upon estimated values for changes in medical costs and work loss for a 50 percent reduction in bad asthma days. The medical cost estimates are either .46 of average variable medical costs for all respondents in the sample being analyzed, or the implicit medical cost WTP reported in Table 4.18 (which used either .46 or one fourth of the respondent's variable medical costs).[14] Reductions in work loss is assumed to equal medical cost changes due to the equal rankings of these categories. The implicit work loss WTP (WTP2) reported in Table 4.18 is used as an alternative basis for estimating the COI work loss measure, although it is not necessarily equal to the wage value of time off work.

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[14] Variable costs were used on the presumption that these would provide a better approximation of marginal costs, the change in costs associated with a change in asthma severity. However, it should be noted that the exclusion of one-time purchases is not necessarily appropriate for permanent reductions in asthma severity. Over time all costs become variable costs. Individuals may be able to sell equipment they no longer need and some asthmatics will not have to make purchases they otherwise would have made. A simple correlation coefficient between our fixed cost estimate and severity was positive and significant, implying that over time this breakdown between fixed and variable costs would not be appropriate. This argument could even be extended to insurance or other medical payment programs (medicare, etc.) where if illness prevalence changes so would the demand for and cost of these medical programs.

The subsequent comparisons of COI and WTP measures will hold only for asthma under the given assumptions and COI definitions. The procedures used to value medical costs and work loss can dramatically affect the COI estimates. For example, variable medical cost estimates for asthma by Willett (1986) are one fourth to one fifth the magnitude of the variable medical costs in this study, largely due to the omission of expenses related to hospital visits, treatment programs, medicines and other costs. Similarly, most studies value work loss days at a selected wage rate, but we find that illness is also likely to affect wage rates. As a result of these factors many COI estimates are likely to understate the COI measure they are estimating.

Some COI measures also include other non-work restricted activities days (RAD's). The analysis in this report concerning chores, leisure and implied WTP's for activity effects suggests that values for non-work RAD's may be substantial.

Individual WTP to COI Ratios

Two approaches can be used to calculate the WTP/COI ratio when viewed from the perspective of the affected individual. The first is to just consider the rankings. If one assumes that the rankings reflect the order of the WTPs for the individual damage components, then the rankings imply that the value of reduced discomfort and activity effects equal or exceed medical costs reductions. If one further assumes medical cost reductions and work loss reductions are approximately equal, as reflected by the rankings, and location WTP (WTP5) is greater or equal to zero, then the individual's total WTP is at least twice as large as the COI estimate for the typical individual (WTP/COI $\geq$ 2).

An alternative approach is to compare the total WTP dollar estimate to the estimated reduction in medical costs and work loss. Using the tax bid sample, the estimated change in medical costs for a 50 percent change in bad asthma days equals .92 (percent change in medical costs from a percent change in asthma, Table 4-10) times .5 (50 percent change in asthma) times \$272 (average medical costs), or \$125. Assuming work loss equals the change in medical costs (based upon the rankings), COI = $250. WTP/COI therefore equals $401/250 = 1.6. Using alternative samples or estimates of WTP for medical costs and work loss (WTP1 and WTP2 from Table 4.18) the estimates of the WTP/COI ratio range up to 3.7.[15] The WTP/COI estimates in the 1.6 to 2.3 range are felt to be the most defensible with the value 2 as an appropriate rule-of-thumb point estimate.

Society WTP to COI Ratios

Society incurs costs and may hold values for reductions in health incidences beyond those of the individual, which may affect the WTP/COI ratio. Society directly incurs the full medical costs including those costs paid by insurance and government programs, while the individual typically perceives less than the full medical costs associated with his illness, particularly if he ignores that portion of insurance premiums and taxes associated with this illness. Further, society directly pays (and is therefore directly concerned with) lost work productivity when an individual is away from work, whereas, the individual may perceive minimal personal loss due to paid sick leave. Others in society may also hold values related to reduced numbers of illness incidents and to reduced severity of sickness for those who are affected. This is reflected in the research of Needleman (1976), where WTP by others to prevent an individual's death increased total WTP by 25 - 100 percent.

If respondents have no insurance or other programs that pay part or all of medical costs, the difference is reduced between what the individual perceives as COI and society perceives as COI. This would also reduce the error in using the individual's WTP/COI ratio to represent society's ratio.

Eleven respondents (13.4 percent) had no insurance or other program that covered the majority of their variable medical expenses related to asthma. Statistics for this group are found in Table 4.20. While several of the respondents could not be included in the implicit WTP calculation using the ranking procedure, all were considered valid respondents in the tax bid analysis. The average tax bid and variable medical costs are substan-

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[15] #1. Tax Bid Sample: Tax Bid / (.46 MEDVHH + WTP2) = $401/($125 + $74) = 2.0. #2. Full Sample: Tax Bid/(.46 MEDVHH + (work loss = .46 MEDVHH)) = $584 / ($125 + $125) = 2.3. #3. Implied WTP Sample: Tax Bid / (WTP1 + WTP2) = $443 / ($45 + $74) = 3.7.

Table 4.20

Statistics for the No-Insurance Sub-sample

							Rank For				
ID#	SEV	GDAY	NBADR	TAXBID	MEDVHH	INC	Med	Work	Residence	Activities	Discomfort
101*	169	4	.5	$300	$20	$27,500	6	6	6	1	6
116*	114	2	1	0	370	12,500	2	6	6	3	1
127*	216	3	93.5	100	80	17,500	3	2	4	5	1
153	198	3	35.5	100	36	17,500	4	1	5	2	3
162	228	4	3	1000	50	7,500	6	1	2	6	3
163	144	3	16.5	500	126	17,500	6	6	2	1	3
164	223	3	10.5	5,000	280	47,500	4	3	5	1	2
167*	254	1	100.5	500	2,380	52,500	3	6	6	1	2
171	240	3	10.5	100	240	17,500	3	4	5	1	2
206	176	2	1	0	420	7,500	1	6	4	2	3
210	177	1	47	1,000	126	42,500	4	3	5	2	1
Average	194	2.64	29	$782	$374	$25,000	3.82	4.0	4.55	2.27	1.91
Average for those where asthma was part of the reason for no insurance*											
	2.5	188	.49	$225	$712	$27,500	3.5	5.0	5.5	2.0	2.0

See Table 4.4 for variable definitions.

* Those who indicated asthma was part of the reason they did not have insurance on ERC General Questionniare #6.

tially higher than for the full sample, which appears in each case to be the result of one substantially higher value. The average number of bad asthma days is also substantially higher for this no-insurance sample than for the full sample.

The rankings for this group are very similar to the rankings of the full sample implying a WTP/COI ratio greater than 2. The WTP/COI ratio using the Tax bid ($782), .46 of variable medical costs ($172) and work loss WTP equal reduced medical costs ($172) is 2.3. This analysis suggests that whether the individual incurs medical expenses directly, or indirectly through the purchase of insurance which pays most of the expenses, does not greatly alter the rankings or general relationship between COI and WTP measures for the individual.

To obtain an estimate of the WTP/COI ratio from a social perspective, we take the individual WTP and COI values and escalate them by estimated social costs and values. On a sample wide basis, households directly pay about one half of variable medical costs and insurance or other programs paid the rest, therefore, the total social medical cost component of COI is approximately double that of the individual. This survey provides no information to gauge the social versus individual perceived costs related to work loss. It is assumed the household does not perceive and/or reflect all of the real costs of paid sick leave and other social costs in their ranking and WTP to reduce work loss. Therefore, for the sake of analysis and following the medical cost doubling, we assume total social work loss costs are double the individual's work loss WTP. In summary, the estimated social COI measure is assumed to be double the individual's COI measure.

The social WTP measure is estimated to be equal to the individual WTP measure plus the difference between total social COI and individual COI (equaling individual COI), plus WTP by others to reduce illness of affected individuals. Let the WTP by others be called Z and monetarily left unquantified. The relationship between social and individual WTP and COIs can be expressed mathematically as:

WTP = Willingness to Pay

COI = Cost of Illness measured using changes in variable medical cost and work loss

MED = reduced variable medical costs

WORK = reduced work loss

X = placeholder for WTP, COI, MED and work

X_s = X paid by society

X_i = X paid by affected individual directly

X_o = X directly paid by others who are not in the affected individual's household

$WTPs = WTP_i + MED_o + WORK_o + Z$

$COI_s = COI_i + MED_o + WORK_o$

$COI_i = MED_i + WORK_i$

Given the assumptions:

$$MED_o = MEDi = WORK_o = WORK_i$$

Then

$$MED_o + WORK_o = COI_i$$

$$COI_s = 2\ COI_i$$

$$WTPs = WTP_i + COI_i + Z$$

and

$$WTPs/COIs = (WTP_i + COI_i + Z)/2\ COI_i$$

The estimated ratio WTP_s/COI_s is dependent upon the sample of observations used and assumptions about Z. Assuming Z equals zero and using the individual WTP_i/COI_i rule-of-thumb of two results in a WTPs/COIs value of 1.5. Using the tax bid sample (WTP_i = \$401, MED_i = \$125, and assuming $MED_i = WORK_i$), the WTP_i/COI_i ratio of 1.6 results in a WTPs/COIs ratio of 1.3. Based upon the other approaches given in footnote 15, the WTPs/COIs value may range up to 2.3. Assuming Z equals 50 percent of the individual's WTP, the WTPs/COIs value ranges from 1.7 to 3.3, with the WTP_i/COI_i rule of thumb value of 2.0 resulting in a WTPs/COI value of 2.0. The WTPs/COIs values in the range of 1.3 to 2.0 are felt to be the most defensible with the value 1.5 an approproate rule-of-thumb point estimate.

Summary

The calculation of WTP/COI ratio undertaken here must be interpreted as suggestive due to measurement error and the assumptions used. With this caveat in mind, the analysis suggests that WTP measures are from 1.6 to 3.7 times COI measures, as we have defined COI measures, with the 1.6 to 2.3 range as most defensible and 2.0 as the best point estimate using the perspective of an individual. Using the prospective of society, the range is 1.3 to 3.3, with the 1.3 to 2.0 range as most defensible and 1.5 as the best point estimate.

A second important finding is that the procedure for estimation of the COI measure is equally important, in terms of errors in measuring value, as is the issue of whether a COI or WTP measure is used. For example, the Willett (1980) study on COI for asthmatics ignored so many variable medical costs categories of significance as to understate average variable medical costs by a factor of 4-5 as compared with our findings. Because few COI studies have available the extensive variable medical cost data obtained in this survey, it is likely that WTP is at least 1.3 to 2.3 times the reported COI estimates.

The results for WTP/COI ratios are for asthma and may not be representative of this ratio for other types of illnesses. We hypothesize that, due to differences in the magnitude of medical costs relative to income constraints and the likely magnitude of work loss, the ratio would be larger for minor health effects such as eye and throat irritation, and lower for major illnesses such as angina or cancer.

4.2.9 Methodology Comments

Several interesting methodological findings were made in the process of analyzing the general questionnaire data. The first concerns the use of the rankings and total tax bid to determine implicit WTP values for damage categories. The use of this procedure relied upon the assumption that the rankings referred to net effects based upon existing medical expenditures. The assumption appears to be warranted in that a consistency check of the procedure with the assumption worked the majority (70+ percent) of the time. Failure of the consistency check (and implicit WTP calculation procedure) seemed largely due to differences in calculations of changes in medical costs in terms of a 50 percent reduction in severity versus the framing of the tax bid question in terms of a 50 percent reduction in bad asthma days.

A second methods finding concerns the design of the payment card used on the tax bid WTP question. The card presented four columns of numbers. Each column presented a linear progression of values. Column 1 increased from $0 to $50 by $10 increments. Column 2 increased from $75 to $200 in $25 increments. Column 3 increased from $300 to $1000 in $100 increments and column 4 increased from $2000 to $10,000 in $1,000 increments. This allowed a wide range to be covered without a great deal of values listed on the card, but does introduce a heteroskedastic measurement error into the process of selecting a value.

Respondents were asked to select a value on the payment card or give any other amount. Only two respondents provided non-listed values. These values ($250, $1500) occurred between the last value of one column and the first value on the next column. Further, of the 68 respondents who gave nonzero bids, 40 (58 percent) gave values listed at the top or bottom of the column with 31 (45 percent) giving values listed at the bottom of columns 1, 2 or 3. This seems to suggest that the value jumps between columns were too large (50 to 100 percent jumps) and that the reported maximum willingness to pay may have increased with smaller breaks between columns (i.e. adding values of $60, $250, $1,500, etc.). It also suggest that a paired logit analysis of the bids, such as used by Loehman and De (1982), may be an appropriate method for better estimating the WTP relationship.

Comparisons using the payment card approach and other bidding formats, reported in Cummings et al (1984), find the payment cards have yielded substantially lower values relative to bidding procedures. In that light, it is again possible the bids reported here are understatements of WTP. Nevertheless, using the payment card approach easily allowed a wide range of values to be presented without starting point bias in a situation where we had no expectation on what typical bids might be. Comparisons to medical costs and rankings also suggested that the vast majority of the bids appeared to be meaningful.

The background data and consistency checks helped improve the ability to evaluate zero bids. Twelve zero bids were received on the tax bid question. Based upon responses to a follow up question (#31b) of the type typically used to evaluate zero bids, eleven were initially evaluated as rejections of the procedure. However, based upon background data and the consistency checks, only 7 zero bids appeared clearly to be rejection or problem bids. We can infer that CV practitioners may be too quick to eliminate zero bids from their samples when the elimination is based only upon simple follow-up questions such as #31b. This may be biasing their mean estimates upward. Respondents may be checking what are deemed to be rejection responses as "added weight" to their value assignment of $0.00.

The tax bid payment vehicle appeared to be clearly superior to the wage approaches. The wage approach could only be used by those individuals who were employed, which limited the sample. It also implicitly required the respondent to accept that changes in working conditions could have a substantial impact upon their asthma, which may have caused rejection of the scenario. There also appeared to be a general unwillingness to consider accepting pay cuts to obtain improvements in asthma. Although from economic theory we would expect a pay cut of some amount to have comparable welfare effects to an increased payment (not necessarily of the same amount), the latter seemed to be an unacceptable consideration for most respondents. The WTP figures which are felt to be most defensible are those based upon the "tax bid" sample, which were subject to the consistency checks. The mean WTP value for this group is $401.

5.0 CONCLUSIONS AND RECOMMENDATIONS

This chapter briefly restates the report's primary conclusions with regard to the primary study questions and provides recommendations for future related research and questionnaire design. The research recommendations are presented in three groups:

- Extentions of the analysis in this report.
- New analyses with the ERC and UCLA data sets.
- New valuation and epidemiology directions.

5.1 CONCLUSIONS

The study's empirical findings support theoretical arguments that many economic valuation studies of changes in health status caused by changes in environmental quality are likely to be biased significantly in the direction of understating theoretically correct economic measures of changes in well-being. The biases come primary from two omissions. The first is in measurement of damages that ignore defensive behavior and related costs, and the second is omitting, perhaps because of the difficulty in measuring, changes in well-being that cannot be tied to market purchases. These include changes in discomfort and activity effects related to illness that still occur after medical care has been obtained.

The principal finding of the daily diary is that asthmatics have fairly accurate perceptions about ambient air pollution conditions and expect their asthma to be aggravated when air pollution is expected to be high. When they expect their asthma to be aggravated by air pollution, they are more likely to change their daily schedule in ways that can be expected to reduce pollution exposure and to reduce asthma symptoms. These changes seem to be in terms of less work/chores/school and substitution from active leisure. The implication of these findings is that these substitutions may bias estimated epidemiological relationships between pollutants and asthma severity toward zero. The use of personal exposure monitors could assist in better estimating the epidemiological relationship when averting behavior occurs. Economic studies that use the epidemiological results, but ignore either averting behavior or their costs, will understate benefits or damages from a change in environmental quality. This is likely to be particularly important when studying asthmatics and other groups with special health concerns who may be more likely to consider the effects of their environment and behavior on their health.

The principal finding of the general questionnaire is that WTP measures for reduction in asthma severity at least 1.3 to 2.0 times the magnitude of COI measures from the perspective of society and even higher from the perspective of the affected individual. The mean WTP for a 50 percent reduction in bad asthma days was $401 and the average value per bad day reduced ranged from $4 to $84 depending upon asthma severity (Table 4.16b). The analysis suggests that for a 50 percent reduction in bad asthma days, expected reductions in discomfort and activity effects are more highly valued than are the expected reductions in medical expenditures. Expected changes in work loss are valued approximately the same as expected changes in medical costs. Another important finding is that many COI studies will, due to the lack of available data, understate the COI measure that they are attempting to measure. The implications of these findings are that COI studies, which may continue to be among the most prevalant means of estimating values for changes in health states due to data availability, may severely understate the desired WTP measure of changes in well-being.

Other important findings are:

- Contingent valuation (CV) methods may be very useful in estimating WTP measure for changes in health status. The tax bid WTP measure in this study appears, by and large, to be consistent with other data provided by the respondent regarding his or her illness severity, and attitudes.

- Improved consistency checks can be built into CV questionnaires and may help to better identify problem bids.

- Even when the work schedule is not affected, changes in activities that may include some activity restrictions, but are not RADs, appear to have substantial value. This might include changes in the type (active versus inactive), location (indoor versus outdoor) or timing of leisure activities.

- When it occurs, asthma causes loss from the usual schedule of work, chores or school and usually occurs in 2 to 3 hour blocks, not in full day blocks.

- For a day with a peak hourly O_3 value equal to the federal standard of 12 pphm, approximately 20 percent of asthmatics in this sample will observe the air pollution and expect it to affect their asthma that day, with men being nearly twice as likely as women to have these perceptions.

5.2 RECOMMENDATIONS

5.2.1 Research Recommendations

Extensions of the Analysis in this Report

Most of the extensions on the reported analyses represent potential econometric improvements. Others could also be suggested. These improvements would undoubtably alter the magnitude of the estimates reported; however, it is unlikely that the thrust of the conclusions in this report would be radically altered. Some of the improvements include:

1. Use of refined severity measures based upon frequency and intensity of asthma incidences and the type and level of medication use. This type of measure has now been developed by UCLA, but was not available for our analysis. It may also be useful to attempt to determine a relationship between the SEV measure used and GDAY and NBAD in order to improve the consistency check procedure, which in one part uses SEV and in another part uses GDAY and NBAD. The consistency check procedure could also be refined by attempting to re-estimate variable medical costs as a function of NBAD and GDAY.

2. Develop a system of equations explaining hours spent in different activities and perceptions about how different factors may affect asthma. This would help to account for the effects of activity changes on asthma as well as asthma on activity changes. The system would have to be constrained because of the limitation on total hours available. A simultaneous model might allow a more accurate estimation of changes in activities that are made in order to avoid worse asthma symptoms. Without a simultaneous system it is impossible to distinguish between these preventive changes, which could be important mitigating behavior, and activity changes that may cause an aggravation of asthma symptoms. Any further analysis of the daily schedule data should include all potential aggravating factors, and lagged variables.

3. If analyses of perceptions about aggravating factors are extended they should use logit types of analyses and include other pollutants, such as TSP and SO_2, and include lagged variables, such as the previous day's ozone levels.

4. The work loss equations would be estimated better using a tobit model.

5. Additional refinements on the ranking data logit functions and linear discriminant functions could improve that analysis.

6. Alternative functional forms and tests of the tax bids could be fruitful. These could include the use of alternative flexible functional forms consistent with alternative utility function specifications, redefining GDAY as a categorical variable, and heteroskedasticity corrections.

7. The ERC and UCLA data could be combined to estimate a direct relationship between oxidant levels and economic measures of well-being for the sample group of asthmatics, by combining the UCLA estimated effects of oxidants on asthma and the ERC estimated effects of changes in asthma on WTP and COI measures.

8. Using the ERC diary data, additional work loss analyses could include a mini-epidemiology study of work loss as a function of ozone, weather, aeroallergens, and the asthma reading the day before. All these data are readily available. The ERC diary combined with background data from the UCLA survey could also be used to better measure work loss and check the consistency of the work loss rankings and implicit WTPs across the sample.

9. Additional analyses on total and fixed medical costs (including insurance) with regard to severity would be useful. Most environmental policy has long run impacts for illness severity. Because fixed costs become variable costs in the long run, if they are related to severity level, they should be included in COI estimates. This could have a significant effect on the previously calculated WTP/COI ratio.

10. A value of information study may be able to be conducted with the UCLA and ERC data. If respondents had perfect information on air pollution conditions they would undertake optimal averting behavior, as predicted by the daily schedule analysis. This would lead to changes in exposures and symptoms (bad asthma days), as predicted by the UCLA analysis. The predicted change in bad asthma days could then be valued with the tax bid analysis, resulting in a valuation of improved information.

The most important extensions and new analyses with the UCLA and ERC data sets, in terms of increasing the provision of immediately useful and professionally defensible policy relevant information, are felt to be numbers 1, 2, 6 and 7.

New Valuation and Epidemiology Directions

11. The results of this study are valid for one group of asthmatics living in one location. Additional studies with other groups of asthmatics, or with other potentially sensitive population groups, could lead to different findings. WTP approaches can be effectively used in this endeavor. Where COI studies are used, some attempt to either estimate all medical costs and work loss components should be made, or expert informants (through low cost telephone surveys of doctors and hospitals) could be used to determine what percent of COI has been estimated. Studies of the WTP type should attempt to examine more than one level change in illness so as to better estimate underlying utility functions.

12. Epidemiology studies should, wherever possible, attempt to examine and incorporate mitigating behavior in the analysis.

13. Future work should investigate our assumptions that the rankings referred to discomfort and activity effects that still occur even when medication or other forms of medical care are used.

14. The ranking consistency check appears to be quite easy to implement and holds potential to imply WTP values for damage categories. An alternative approach, which is more difficult for respondents, is to ask the percent of the bid attributable to reductions in each damage category. A useful research effort would be to use and compare the two approaches in the same survey instrument.

15. The findings with regard to WTP/COI ratios are illness specific. We would hypothesize that this ratio would be a function of the severity of the illness and other characteristics. For example, the WTP/COI ratio may be much larger for minor illnesses experienced by the general populations such as eye and throat irritation where medical costs and work loss are very minimal. The WTP/COI ratio may be close to one for aggravation of major illnesses, such as angina, or cancer risks,

where income constraints may become more important in terms of medical costs and WTP. Additional studies of this type for different types of illnesses are recommended before the ratios provided in this report become widely used.

16. A future survey effort could attempt to estimate WTP indirectly by obtaining data on all right hand side variables of equation 2.23 using an expenditure function approach, although a WTP question may be needed to again ascertain the discomfort values.

17. A related study could be performed with the UCLA CORD population (described in Chapter 3). Researchers have followed this population for several years recording location, physical functioning and other background data. This much larger group could be contacted through a mail CV instrument. The purpose would be to test a CV mail approach to the same valuation questions, address a much broader group of individuals with respiratory illness as an extension and validation of the results in this report and examine hypotheses regarding moving costs as a WTP measure.

The most important future directions are felt to be numbers 12 and 15.

5.2.2 Questionnaire Design Recommendations

Overall, the questionnaires worked very well in obtaining the data desired in order to address the study questions and hypotheses. Nevertheless, due to the breadth of issues that were being addressed, the short time frame during which the instruments were developed and other survey constraints, and several new applications being tried, there are numerous areas where the wording or approaches used could be improved in future applications that attempt to build on this effort. Several of the more important or useful alterations are listed for each survey instrument. Elaborations were generally provided in the text of the report.

Daily Diary

1. Diary question #4 should have had a category for sick/sleep or other inactive time.

2. Undertaking the survey during a period with higher air pollution readings may have improved the ability to check perceptions and behavior in response to air pollution changes.

3. A question identifying whether this was a regular work schedule day, or other day (such as weekend day or day off work) would have improved the interpretation of the daily schedule data.

4. Clarifying whether time off work was from paid work or from chores would improve the accuracy of work loss estimates using this type of approach in the future.

General Questionnaire

5. Increased detail on the estimated medical costs and insurance coverage would have greatly improved the ability to use this data in the consistency checks and implicit WTP calculations.

6. Careful attention to the design of the analysis such that medical costs and the tax bid WTP could be accurately tied to the same illness severity measure would again improve the ability to use the ranking consistency check and implicit WTP calcualtion procedure, although this may not always be easy.

7. Deleting some of the supporting information on leisure, chores, work loss and the like would diminish some of the buildup leading to the ranking and tax bid questions, but would allow more interview time and energy to address valuing changes for more than one alternative health status level and improve the estimation of underlying utility functions.

8. Words like pain and suffering are generally too strong and terms such as discomfort should be substituted.

9. Work/wage-based CV approaches are not recommended unless all illness is job related.

10. Two alternative WTP levels should have been examined.

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APPENDIX

SURVEY MATERIALS

GLENDORA–UCLA ASTHMA RESEARCH STUDY NAME: ____________________

WEEKLY DIARY FORM CODE: ____________________

Date this diary started ______________________.
Month Day Year

1	2	3	4	5	6	7
NONE	VERY MILD	MILD	MODERATE	MODERATELY SEVERE	SEVERE	VERY SEVERE

INSTRUCTIONS: Please rate your symptoms below for the degree of discomfort (severity) each one caused you, using this seven-point scale:

GRADING SCALE FOR SYMPTOMS (Degree of discomfort)

1 = None (did not occur)
2 = Very mild discomfort
3 = Mild discomfort
4 = Moderate discomfort
5 = Moderately severe discomfort
6 = Severe discomfort
7 = Very severe incapacitating discomfort

	Sx1	Sx2
NIGHT	☐☐	☐☐
DAY	☐☐	☐☐

NIGHT RATING

Enter Night Ratings on WAKING in the morning.

DATE							
DAY							
WHEEZING							
SHORTNESS OF BREATH							
CHEST TIGHTNESS							
COUGHING							
SPUTUM PRODUCTION							
TENSION OR ANXIETY							
ANY OTHER (Specify)							
ANY OTHER (Specify)							
OVERALL ASTHMA RATING							
TIMES AWAKENED BY ASTHMA							
AVERAGE DURATION OF ATTACKS (No. of hours)							
PEAK FLOW GAUGE READINGS (MORNING) 1							
2							
3							

DAY RATING

Enter Day Ratings just before RETIRING for the night.

DATE							
DAY							
WHEEZING							
SHORTNESS OF BREATH							
CHEST TIGHTNESS							
COUGHING							
SPUTUM PRODUCTION							
TENSION OR ANXIETY							
ANY OTHER (Specify)							
ANY OTHER (Specify)							
OVERALL ASTHMA RATING							
NUMBER OF ASTHMA ATTACKS							
AVERAGE DURATION OF ATTACKS (No. of hours)							
PEAK FLOW GAUGE READINGS (EVENING) 1							
2							
3							

ERC Energy and Resource Consultants, Inc.
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October 3, 1983

TO: Participants in the UCLA Glendora Asthma Research Study

Dear Participant:

You are being asked to participate in a parallel survey called the Asthma Behavior and Expenditures (ABE) Study that will examine how your asthma affects your work, school and leisure activities, and your medical care.

We believe this research effort will improve the scientific understanding of how asthma affects a person's well-being. Your participation will help all asthmatics whose circumstances may be improved as a result of this understanding. We hope you will choose to participate.

The survey will consist of three parts.

1. While you are at the Glendora facility, we will answer your questions about the study, have you sign a consent form and explain the daily diary.
2. You will be given simple diary forms to take home and complete during the next four weeks. These diaries will take one or two minutes to complete each evening.
3. When you visit the UCLA Glendora facility in late November you will be given a concluding survey about changes in your activities and expenditures you make to cope with your asthma. These questions will take about ten to fifteen minutes to complete.

Taking part in this study is voluntary. You should not participate if you believe it may hurt your ability to continue with the UCLA Asthma Research Study.

Participants in the Asthma Behavior and Expenditures (ABE) Study will receive an additional $25 compensation at the conclusion of the November interview. This study is being sponsored by the U.S. Environmental Protection Agency and the State of California in cooperation with Energy and Resource Consultants, Inc., of Boulder, Colorado, and the UCLA School of Medicine.

Sincerely,

Robert D. Rowe, Ph.D.
Director, Asthma Behavior and Expenditures Study

Henry Gong, M.D.
Director, UCLA Asthma Research Study

E
R
C

Energy and Resource Consultants, Inc.

P.O. Drawer O, Boulder, CO 80306 • (303) 449-5515

October 3, 1983

TO: Parents of UCLA Glendora Asthma Research Study Participants Who are Under the Age of 16.

Dear Parent:

You are being asked to participate in a parallel survey called the Asthma Behavior and Expenditures Study that will examine how your child's asthma affects his or her school and leisure activities, and medical care.

We believe this research effort will improve the scientific understanding of how asthma affects a person's well-being. Your participation will help all asthmatics whose circumstances may be improved as a result of this understanding. We hope you will choose to participate.

As parents, your participation includes:

- Coming to the Glendora facility with your child during the late November visit, signing a consent form and taking a ten to fifteen minute survey about your child's activities and your medical expenditures to cope with his or her asthma.

We would appreciate if you could indicate your willingness to participate by signing and returning this letter at your next visit to the center, or by calling the center at telephone # 914-4591.

Taking part in this study is voluntary. You should not participate if you believe it may reduce your child's ability to continue with the UCLA Asthma Research Study.

Participants in the Asthma Behavior and Expenditures Study will receive an additional $25 compensation at the conclusion of the November interview. This study is being sponsored by the U.S. Environmental Protection Agency and the State of California in cooperation with Energy and Resource Consultants, Inc., of Boulder, Colorado, and the UCLA School of Medicine.

Sincerely,

Robert D. Rowe, Ph.D.
Director, Asthma Behavior and Expenditures Study

Henry Gong, M.D.
Director, UCLA Asthma Research Study

We are willing to participate
in the Asthma Behavior and
Expenditures (ABE) Study

____
Signature of Parent or Guardian

CONSENT FOR PARTICIPATION IN THE ASTHMA BEHAVIOR AND EXPENDITURES STUDY

By participating in the Asthma Behavior and Expenditures (ABE) Study I acknowledge and agree to the following:

1. My participation and all answers are provided voluntarily. I may refuse to answer questions that I feel violate my privacy.
2. All data received by ABE sponsors will be coded to retain my complete confidentiality. My name, address or phone number will not be included.
3. Data for the UCLA Asthma Research Study may be provided to the ABE Study; however, this data will be coded to retain my complete confidentiality. My name, address and phone number will not be included.
4. Conditions of the UCLA informed consent form, which I signed earlier, will not be altered.
5. I will receive $25 in compensation after completing the concluding interview around the end of November.
6. The ABE sponsors are the U.S. Environmental Protection Agency, the State of California, and Energy and Resource Consultants, Inc., in participation with the UCLA Schools of Medicine and Public Health.

Signature of Participant	Date
Signature of Parent or Guardian of Participant Under the Age of 18	Date

CODE #________

ASTHMA BEHAVIOR AND EXPENDITURES (ABE) STUDY

GENERAL QUESTION #1

(As Part of Diary Instruction #2 and
To Be Retained By Interviewer)

Using the UCLA scale, please circle the highest overall daytime asthma rating that you would still consider to be a GOOD ASTHMA DAY for yourself.

BAD ASTHMA DAYS would be days with an overall asthma rating above this. (Divide Scale into GOOD ASTHMA DAYS and BAD ASTHMA DAYS.)

1	2	3	4	5	6	7
None	Very Mild	Mild	Moderate	Moderately Severe	Severe	Very Severe

ASTHMA BEHAVIOR AND EXPENDITURES (ABE) STUDY
DAILY DIARY INSTRUCTIONS

1. The ABE diary is to be completed at the end of each day after completing the UCLA diary. The UCLA diary entries are very important and must first be completed as accurately as possible.

2. The ABE diary is concerned with the effects of your asthma on your daily activities. Some of the questions refer to GOOD ASTHMA DAYS and BAD ASTHMA DAYS. This distinction is for you to judge.

3. Some of the questions on the ABE diary refer to days when you start off feeling as though your asthma might result in a BAD ASTHMA DAY whether or not this actually occurred.

   Mark the factors in Question #1 that you were concerned might have made your asthma worse, whether you had a BAD ASTHMA DAY or not.

   Answer YES to Question #2 if at the start of your day you thought you might have had a BAD ASTHMA DAY, whether or not it actually occurred.

4. For Question 3, please assess how your asthma affected your performance at whatever paid work, schoolwork and household chores you do. If you are a homemaker or retired, please answer for your housework chores or other activity that you consider work. Include commuting time as part of your work activity.

5. Examples of the various categories of activities in Question 4 include:

Indoor household chores:	cooking, cleaning
Outdoor household chores:	gardening, auto fix-up, lawn work
Active indoor leisure:	dancing, bowling, racquet ball
Inactive indoor leisure:	watching TV, reading, visiting with family and friends, eating
Active outdoor leisure:	walking, playing ball, bicycling
Inactive outdoor leisure:	watching sporting events, picnicking, sitting on the porch

ADULTS

GLENDORA-ASTHMA BEHAVIOR AND EXPENDITURE STUDY
WEEKLY DIARY FORM

CODE # ____________

Date this diary started ________ month ________ day

Date							
Day							

1. WHEN YOUR DAY STARTED, WHAT DID YOU FEEL MIGHT AFFECT YOUR ASTHMA TODAY? CHECK ALL THAT APPLY.

I DIDN'T EXPECT ANY SYMPTOMS TODAY							
ILLNESS, COLDS, FLU							
TENSION, STRESS, ANXIETY							
EXERCISE							
AIR POLLUTION							
ANIMALS, PLANTS, POLLENS							
WEATHER							
A BAD DAY YESTERDAY							
NOTHING IN PARTICULAR/DON'T KNOW							
OTHER (SPECIFY)							

2. WHEN YOUR DAY STARTED, DID YOU THINK YOU MIGHT HAVE ASTHMA SYMPTOMS THAT WOULD RESULT IN A BAD ASTHMA DAY (EVEN IF THEY DID NOT OCCUR)?

YES							
NO							

3. HOW DID YOUR ASTHMA SYMPTOMS AFFECT YOUR WORK, SCHOOLWORK OR HOUSEHOLD CHORES TODAY COMPARED WITH MOST GOOD ASTHMA DAYS? CHECK ALL THAT APPLY.

MORE ENJOYABLE							
LESS ENJOYABLE							
MY PERFORMANCE WAS IMPROVED							
MY PERFORMANCE WAS REDUCED							
I TOOK TIME OFF COMPARED TO MY USUAL SCHEDULE							
ENTER # OF HOURS TAKEN OFF							
NO EFFECT							

4. IN THE LAST 24 HOURS, ABOUT HOW MANY HOURS DID YOU SPEND IN EACH OF THESE TYPES OF ACTIVITIES?

INDOOR HOUSEHOLD CHORES							
OUTDOOR HOUSEHOLD CHORES							
ACTIVE INDOOR LEISURE							
INACTIVE INDOOR LEISURE							
ACTIVE OUTDOOR LEISURE							
INACTIVE OUTDOOR LEISURE							

5. DID YOU CHANGE YOUR LEISURE ACTIVITIES (TIMING OR # HOURS) TODAY TO AVOID HAVING OR WORSENING ASTHMA SYMPTOMS THAT YOU WOULD CONSIDER TO BE A BAD ASTHMA DAY?

YES							
NO							

6. DID YOU CHANGE YOUR SLEEP ACTIVITIES (TIMING OR # HOURS IN BED) TODAY TO AVOID HAVING OR WORSENING ASTHMA SYMPTOMS THAT YOU WOULD CONSIDER TO BE A BAD ASTHMA DAY?

YES							
NO							

☐ 1
1

ASTHMATIC BEHAVIOR AND EXPENDITURES STUDY
GENERAL QUESTIONNAIRE

ADULT VERSION OF Questionniare. Results Combined for Adults and Children

☐☐☐ ID#
2 3 4

☐ 1 CARD #
5

☐ INTERVIEWER #
6

Adults-64 (78%)
Children-18 (22%)
Total-82

Interviewer #1-96.3% Interviewer #2-3.7%

These questions have to do with how your asthma affects your health expenditures, your work, your leisure, and where you live. Some questions are similar to those in earlier UCLA questionnaires. This is done so that we will have the most up-to-date information.

Your responses will help improve the scientific understanding of how asthma affects a person's well-being. Your careful consideration of each question is appreciated. All your answers are voluntary and will be confidential. Please do not hesitate to ask me to repeat any question.

Some of these questions refer to Bad Asthma Days, just as on the daily diary. Again, you are the judge of what is a Bad Asthma Day.

Here is a booklet to help you answer some of the questions. Please do not turn to the first page until you receive instructions to do so. (HAND NOTEBOOK) Not all questions are in the booklet and you will be skipping some of the questions in the booklet, so please wait for instructions before continuing in the booklet.

☐ highest good day
7

GDAY VALUE	1	2	3	4
% respondents	3.7%	26.8%	50%	19.5%

PART I. OTHER ASTHMATICS IN THE HOUSEHOLD

QUESTION 1.

☐☐
8 9

a. How many people live in your household?
Mean 3.45 **(IF 1 SKIP TO QUESTION 3)**

b. Are there other asthmatics in your household?
69.5% NO. (0)(SKIP TO PART II)
30.5% YES. (1)(CONTINUE)

☐
10

25 respondents → asked question 2a and 2b

QUESTION 2.

☐
11

a. Please rate your asthma as either mild (1), moderate (2), or severe (3)
_________ (Rating) 1=48% 2=52%

b. Please give the relationships of other asthmatics in the household and rate their asthma as either mild, moderate, or severe.

	Relationship	MILD (1)	MODERATE (2)	SEVERE (3)
1	Ownrating as % of family	mean= 50.4%	Standard error=12.36	
2				
3				
4				

☐☐
12 13

PART II. EXPENDITURES

QUESTION 3. As a result of asthma, what types of medical supplies, household supplies, equipment and special treatment programs do you and members of your household buy or use, that you would not have purchased or would not use if you (and other members of your household) did not have asthma? To help you, please look at the list of items on the first page of the notebook, which is titled Question 3.

a. Have you purchased or do you rent _________________ that you would not otherwise have if no one in your household had asthma? (IF NOT USED, CHECK COLUMN #1)

b. Is this a one-time purchase or something you purchase or rent from time to time? (CHECK EITHER COLUMN 2 OR COLUMN 3.)

(CONTINUE THROUGH LIST AND ASK FOR OTHER ITEMS THAT HAVE NOT BEEN LISTED, EVEN IF INFREQUENTLY USED.)

QUESTION 4. a. Please estimate the one-time purchase price or costs per year of buying or renting each item. (COLUMN 4)

b. Is this mostly paid by your household or by a medical payment program (such as health insurance, MEDICAL, HMO, etc.)? (WRITE 'YES' OR 'NO' IN COLUMN 5.)

Column	(1)	(2)	(3)	(4)	(5)
	CHECK IF				
Item	Not Used	One time Purchase	Periodic Purchase or Rental	Cost to Buy or Annual Cost	Household Pays Most (Yes/No)
Medications for Asthma*					
Air Purifier					
Intermittent Positive Pressure Breathing Machine (IPPB)					
Hand Held Nebulization Machine					
Masks					
Oxygen					
Special Treatment Programs (SPECIFY) ______					
Relandscaping the Yard					
Other (SPECIFY) ______					
Other (SPECIFY) ______					
Other (SPECIFY) ______					
Other (SPECIFY) ______					

	Total	This Asthmatic
Household paid fixed costs	$618.8	$485.7
Household paid variable costs	$267.9/yr	$207.5/yr
Total Fixed costs	$713	$573
Total Variable costs	$528/yr	$435/yr

*Includes bronchodilators, inhalers, tablets, steroids, etc.

14	15	16	17	18
19	20	21	22	23

QUESTION 5. a. In the last year, have you been admitted to the hospital for your asthma?

☐ 24

_____ NO. (0) **(SKIP TO QUESTION 5b)**

9.8% (N=8) YES. (1) (CONTINUE)

On your last visit, how many days did you stay? _____

☐☐☐☐☐ 25 26 27 28 29

On your last visit, what type of treatment did you have? _____

Mean for 8 respondents
$1540.
Mean costs for all 82 respondents =$150.25

b. In the last year, have you visited the hospital emergency room for your asthma?

☐ 30

_____ NO. (0) **(SKIP TO QUESTION 5c)**

25.6% (N=21) YES. (1) (CONTINUE)

On your last visit, what type of treatment did you have? _____

☐☐☐☐ 31 32 33 34

Mean Costs for 21 respondents =$142
Mean2costs for all 82 respondents =$36.28

c. In the last year, have you visited the doctor's office because of your asthma?

☐ 35

_____ NO. (0) **(SKIP TO QUESTION 6)**

75.6%(n=62) YES. (1) (CONTINUE)

Mean costs for 62 respondents =$30. Mean costs for 82 respondents =$22.68

On your last visit to the doctor's office what type of treatment did you have?

☐☐☐☐ 36 37 38 39

_____ Regular check-up
_____ Other (SPECIFY) _____

QUESTION 6. Do you have a medical payment program (such as health insurance, MEDICAL, HMO, etc.) that covers any of your doctor and hospital expenses related to your asthma?

13.4% (11) NO. Is your asthma part of the reason why you do not have such insurance?

8.5% (7) NO. (0) **(SKIP TO PART III)**
4.9% (4) YES. (1) **(EXPLANATION IF OFFERED)** _____

☐ 40

86.6% YES. (2)

PART III. WORK AND SCHOOL

This section asks about how your asthma affects you at work and school.

QUESTION 7. 64 ADULTS
Please turn to the page titled Question 7. Which of the following describe your present employment status? (MULTIPLE ANSWERS ALLOWED)

If checked, enter 1 in column →

41 62 53% (40) a. Employed full-time (1)
42 10.88% (7) b. Employed part-time (2)
43 15.62%(10) c. Homemaker (3)
44 4.72%(3) d. Retired (4)
45 2.56%(2) e. Retired due to health reasons (5)
46 14%(9) f. Student (6)
47 4.7%(3) g. Not presently employed, but looking for employment (7)
48 0% h. Other (SPECIFY) _____ (8)

QUESTION 8. Please turn to the page titled Question 8. Please indicate the answers that describe how your asthma affects your current employment status.

f checked, enter 1 in column →

64 Adults Only

49 87.4%(56) a. My asthma is not important or is of minor importance to my current employment status.

6.25%(4)

50 ______ b. Because of my asthma, I am a homemaker, a student, retired, or unemployed.

51 0 c. Because of my asthma, I do not work at all during part of the year (LIST SEASONS OFF WORK) ______

52 4.7%(3) d. Because of my asthma, I work only part-time year round

53 0 e. Because of my asthma, I work only part-time during part of the year (LIST SEASONS OFF WORK) ______

54 0 f. Other (SPECIFY) ______

☐ ☒
55 80

(IF NOT A STUDENT OR NOT EMPLOYED SKIP TO PART IV)

(READ QUESTION 9 ONLY IF A STUDENT.) 27 Respondents 18 Children, 9 Adults

QUESTION 9. a. In the last year, has your asthma affected your performance at school?

☐ 56

27%(10) NO. (0)

63%(17) YES. (1) Do you believe this hurts your grades?

☐ 57

35.3%(6) NO. (0)

64.7%(11) YES. (1)

b. Does your asthma affect your participation in extracurricular activities?

☐ 58

27% (10) NO. (0)

63%(17) YES. (1)

c. Do you live at home? (ADULTS ONLY)

☐ 6059

22%(2) NO. (0)

78%(7) YES. (1)

(READ QUESTIONS 10 THROUGH 15 ONLY IF EMPLOYED)
ADULTS ONLY n=64 47 total employed full time or part time.

QUESTION 10. During October and November, how many hours per week did you typically spend at work and traveling to and from work?

☐ 60 61 | mean 41.5 hours hours/week

QUESTION 11. Has your asthma affected your choice of jobs?

☐ 62

57.5%(27) NO. (0)

42.4%(20) YES. (1) ↘ Of 20 → a. How has your choice been affected?

☐ 63

65%(13) a. I work at a less strenuous or less stressful job than I would otherwise choose. (1)

10%(2) b. I work at a different location than I would otherwise choose. (2)

25%(5) c. Other (SPECIFY) ______ (3 -8)

______

b. Do you believe this has affected your income?

☐ 64

40%(8) NO. (0)

60%(12) YES. (1)

QUESTION 12. Do you think that your asthma could be better under different working conditions than you now have?* 47 Adults employed Ft or Pt

☐
65

60%(28) NO (0) **(SKIP TO QUESTION 14)**

40%(19) YES (OR MAYBE)(1) **(CONTINUE)**

QUESTION 13. a. Please turn to the page titled Question 13a. Please think about a situation where you are offered a job similar to what you now have, but you could expect to have Bad Asthma Days about half as often as you do now.* What would be the biggest pay cut you would accept and still take the new job? The list of dollar amounts is only to help you. Please feel free to select a listed amount or give any other amount.

☐☐☐☐
66 67 68 69

$ Mean $.9615/~~Year/Week~~/Hour ← 5 non zero bids=1.00,1.50,2.00,3.00,5.00
8 accepted $0.00 bids
Standard Error of mean .5518 6 zero or blanks treated as rejections

(ASK 13b IF RESPONSE TO 13a WAS $0.0 OR RESPONDENT REFUSED TO CONSIDER THE JOB CHANGE, OTHERWISE SKIP TO PART IV)

b. Please turn to the page titled Question 13b. Which of the following reasons best explains your answer to the previous question #13a?

☐
70

8 a. Having Bad Asthma Days half as often would not be worth any pay cut.
5 b. I couldn't get by with less pay than I now receive.
1 c. I don't believe that a job change could reduce my asthma that much.
___ d. I would not want to give up the other benefits of my current job.
___ e. Other (PLEASE SPECIFY) ____________________

answer b and c treated as vehicle or scenario rejections

~~(SKIP TO PART IV)~~

QUESTION 14. Do you think your asthma might be worse under different working conditions than you now have?**

☐
71

2.1%(1) NO (0) **(SKIP TO PART IV)**

97.9%(46) YES (OR MAYBE)(1) **(CONTINUE)**

QUESTION 15. a. Please turn to the page titled Question 15a. Please think about a situation where you are offered a job similar to what you now have, but you could expect to have Bad Asthma Days about twice as often as you do now. What would be the smallest pay increase you would require to take the new job? The list of dollar amounts is only to help you. Please feel free to select a listed amount or give any other amount.

☐☐☐☐
72 73 74 75

$ Mean=$5.36 /~~Year/Week~~/Hour ← 23 non-zero bids ranging from $1 to $10.
1 accepted zero bid
22 rejection zero bids
20 infinite bids or no play

Standard error of mean=$.6765

---

76 ☐ 1 person *IF REQUESTED ADD: This question is hypothetical but for some people this could occur through lowered stress or work effort; less exposure to pollens, air pollution, or dust; more flexible working hours; less travel; or company paid desensitizing programs.

77 ☐ 1 person ** IF REQUESTED ADD: This question is hypothetical but for some people this could occur through more stress or work effort; more exposure to pollens or air pollution; less flexible working hours; or more travel.

(ASK 15b IF RESPONSE TO 15a WAS $0.0 OR RESPONDENT REFUSED TO CONSIDER THE JOB CHANGE, OTHERWISE SKIP TO PART IV)

b. Please turn to the page titled Question 15b. Which of the following reasons best explains your answer to the previous question #15a?

☐ 78 treated as	20	a.	No pay increase would make me willing to have Bad Asthma Days twice as often.
Rejection	2	b.	I don't believe that a job change could increase my asthma that much.
Bids	0	c.	I would not want to give up the other benefits of my current job.
☐☐☐ ID# (1 2 3)	1	d.	Other (PLEASE SPECIFY) Just wouldn't want to change jobs treated as valid $0 bid

4 ☐2 Card #

PART IV. NON-PAID CHORES

ADULTS ONLY N=64

The next questions ask about the non-paid chores you do, such as cooking, cleaning, child care, yard work, auto fixup, house maintenance, and volunteer work.

QUESTION 16. In the past year, has your asthma at times affected your ability to perform these chores?

☐ 5

20%(12) NO (0) **(SKIP TO PART V)**
80%(52) YES (1) (CONTINUE)

(SKIP QUESTION 17 IF STUDENT LIVING AT HOME)

QUESTION 17. a. Because of your (and your household's) asthma, does your household hire someone else on a regular basis, such as every day, every week, or every month, to do household chores and maintenance? Answer NO if your household would still hire these services if your (and your household's) asthma were less severe.

52 respondents

☐ 6

20.8%(42) NO (0) **(SKIP TO QUESTION 18)**
19.2%(10)YES(1) (CONTINUE, WRITE ANSWERS TO b, AND c BELOW)

b. What chores does your household regularly hire out because of your (and your household's) asthma?

c. How often is this service performed by someone else for pay?
(Daily=1; Weekly=2; Monthly=3; Yearly=4)

CHORE	HOW OFTEN
Average yearly costs for 10	respondents =$1,478/year
Average yearly costs over	entire sample =$180.24/year

☐☐☐☐☐
7 8 9 10 11

52 respondents as 12 adults listed no effect to question 16

QUESTION 18. Some chores need to be done most every day. For example, these might include cooking, some cleaning and child care. Please turn to page titled Question 18. Please think only about those chores that you usually do that need to be done most every day. When you have a Bad Asthma Day, or a period of time with frequent Bad Asthma Days, how do these chores that you usually do get done? Please pick the best answers.

If checked, enter
1 in column →

12 34.6% (18) a. I usually still do them, but they are less enjoyable. (1)
13 42.3%(22) b. I usually still do them, but it takes longer. (2)
14 25%(13) c. I usually still do them, but at a different time of day. (3)
15 28.8%(15) d. I usually have someone else in the household do them. (4)
16 55.8%(29) e. They usually just don't get done that day. (5)
17 5.8%(3) f. Usually someone outside of the household does them (6)
(such as going out to eat, hiring a housecleaner, etc.) (7)
18 ________ g. Other (Please Explain) ______________________ (8,9)

Total 192.3% or nearly two responses per respondent

PART V. LEISURE ACTIVITIES

This section asks how your asthma affects your leisure activities, that is the things you do in your free time that you do not consider to be chores or work.

QUESTION 19. In the last year, has your asthma affected your leisure activities?

☐
19

25.6%(21) NO (0) **(SKIP TO SECTION VI)**
74.4%(61) YES (1) (CONTINUE)

QUESTION 20. 64 ADULTS ONLY

During the past month while you were completing the ABE daily diary, were there any days when your asthma caused you to be so sick that you were basically bedridden and unable to perform your usual work, chores, or leisure activities?

☐
20

60 NO. (0) **(SKIP TO QUESTION #21)**
3 YES. (1) (CONTINUE)

How many days were you sick and basically bedridden because of your asthma while you were completing the ABE diary? (EXCLUDE ANY HOSPITALIZED DAYS WHEN THEY DID NOT COMPLETE THE DIARY)

☐☐
21 22

mean =2 ______ days
values received =1,2,3 days

QUESTION 21. Please turn to the page titled Question 21. When you are having a Bad Asthma Day that affects your leisure activities, which of the following describe how your leisure activities are affected? Please pick all that apply.

If checked, enter
1 in column →

23 35.4%(29) a. I usually change the types of activities I do.
24 12.2%(10) b. I usually do the same activities, but at a different time of the day.
25 56.1(46) c. I usually spend less time on leisure activities.

PART VI. RESIDENTIAL LOCATION

QUESTION 22. How long have you lived in the greater Los Angeles area?
☐☐ Years
26 27
mean=24.8 years

QUESTION 23. How long have you lived in the Glendora area?
☐☐ Years
28 29
mean=15.1 years

QUESTION 24. Does your household own or rent your current residence?
☐ 30
26.8%(22) Rent (0)
73.2%(60 Own (1), For how many years? mean 9.0 years
☐☐ 31 32

QUESTION 25. Some people think their asthma is affected by where they live. Do you think living in different communities would have different effects on your asthma?
☐ 33
17.1%(14) NO. (SKIP TO PART VIII)
82.9%(68) YES OR MAYBE. (INCLUDES SOME THINGS ARE BETTER; SOME THINGS ARE WORSE.)

(IF STUDENT LIVING AT HOME, ASK QUESTIONS 26, 27, AND 28 IN TERMS OF WHEN THEY FINISH SCHOOL)

68 RESPONDENTS

QUESTION 26. Have you and your household ever considered moving away from Glendora in order to reduce your exposure to those things that worsen your asthma?
☐ 34
39.7%(27) NO. (SKIP TO QUESTION 27)
60.3%(41) YES. (IF YES, ASK) Please turn to the page titled Question 26. By moving, what things that worsen your (or your household's) asthma would you be avoiding?

If checked enter 1 in column →

35 9.5%(8) a. Stress, tension, anxiety
36 87.8%(36) b. Air pollution
37 41.5%(17) c. Pollens, plants and animals
38 29.3%(12) d. Weather in this area
39 ______ e. Other (SPECIFY) ____________

Total =188% or nearly two items checked per respondent

QUESTION 27. a. Would you move to another community in the greater Los Angeles area if you thought you would have about half as many Bad Asthma Days* as you now have?
☐ 40 68 respondents
39.7%(27) YES. (1) (SKIP TO PART VII)
58.9%(40) NO. (0) (CONTINUE)

40 respondents

b. Please turn to the page titled Questions 27 and 28. Which of the following reasons explain why you would not move? (MULTIPLE ANSWERS ALLOWABLE)

If checked enter 1 in column →

41 32.5%(13) a. Family and friends here.
42 55.0%(22) b. Job here.
43 37.5%(15) c. The change in asthma would not be important enough.
44 32.5%(13) d. The moving costs would be too high.
REJECTION→ 45 55%(22) e. I don't believe there is any place in the Los Angeles area where my asthma could be that much better. (IF CHECKED, SKIP TO PART VII)
46 ______ f. Other (SPECIFY) ____________

---

47 ☐ NEVER USED

* IF REQUESTED ADD: This question is hypothetical but for some people this could occur through lower stress; less exposure to air pollution, pollens and plants; or a difference in weather.

QUESTION 28. a. Would you move to another community in the greater Los Angeles area if you thought you would have almost no Bad Asthma Days after moving?

☐ 48

59.3%(32) YES. (1) **(SKIP TO PART VII)**
40.7%(22) NO. (0) NOTE INTERVIEWER INCONSISTENCY IN ASKING THIS QUESTION
N=54

22 respondents

b. Look again at the page titled Questions 27 and 28. Which of the following reasons explain why you would not move? (MULTIPLE ANSWERS ALLOWABLE)

If checked enter 1 in column →

49 36.4%(8) a. Family and friends here.
50 59%(13) b. Job here.
51 45.5%(10) c. The change in asthma would not be important enough.
52 41%(9) d. The moving costs would be too high.
53 41%(9) e. I don't believe that there is any place in the Los Angeles area where my asthma could be that much better.
54 ______ f. Other (SPECIFY) ______________________

PART VII. OTHER

QUESTION 29. Please turn to the page titled Question 29. Here are some possible benefits you might receive from having your asthma improve. Please take your time and rank them from most important to least important. Exclude any that are of no importance.

times ranked

1st	2nd	3rd	4th	5th	not ranked	category
12	14	19	8	5	24	a
7	20	14	11	2	28	b
1	6	9	10	16	40	c
22	20	12	13	3	12	d
40	19	11	1	4	7	e

CATEGORIES

a. Lower expenditure on doctors, hospitals, medicines, special equipment and services.
b. Higher productivity at work/or ability to get higher wages and salaries.
c. More flexibility about where to live.
d. Better chance to participate in desired leisure, recreation and social activities.
e. Less pain and suffering.

(SKIP QUESTION 30 IF STUDENT LIVING AT HOME)

QUESTION 30. a. Please turn to the page titled Question 30a. If federal, state, or local governments set up programs that could reduce pollens, dusts, air pollutants and other factors throughout this area that might reduce your (and your household's) Bad Asthma Days by half, but would cost you increased tax dollars, what would be the maximum increase in taxes each year that you and your household would be willing to pay and still support such a program? The list of dollar amounts is only to help you. Please feel free to select a listed amount or give any other amount.

☐☐☐☐☐
60 61 62 63 64

Mean= $584 $/Year.
Standard error of mean =$112.3

{ Based upon 69 non-zero bids
1 accepted zero bid
12 rejected to play or rejection zero bid based upon question 30b

(ASK 30b IF RESPONSE TO 30a WAS $0.0 OR RESPONDENT REFUSED TO CHOOSE ANY DOLLAR AMOUNT, OTHERWISE SKIP TO QUESTION 31).

b. Please turn to the page titled Question 30b. Which of the following reasons best explains your answer to the previous question #30a?

13 total respondents

☐ 65

7.7%(1)	a.	Having Bad Asthma Days half as often would not be worth any increase in taxes.	(1)
54% (7)	b.	Our taxes are already too high.	(2)
23%(3)	c.	I don't believe any such program could reduce my Bad Asthma Days by half.	(3)
	d.	I should not have to pay for such programs; they should be undertaken by government and industry without any increase in taxes.	(4)
15.4%(2)	e.	Other (PLEASE SPECIFY) Rejection responses	(5)

QUESTION 31. Please turn to the page titled Question 31. Here is a list of income categories. Please give the code letter of the category that best describes the combined before taxes income that you and all other members of your household expect to receive in 1983. Please include wages, salaries, net income from businesses, pensions, dividends, interest, and other income.

☐☐☐☐☐ 66 67 68 69 70

2.4%(2)	a.	Under $5,000
6.1%(5)	b.	$ 5,000 - $ 9,999
4.9%(4)	c.	$10,000 - $14,999
15.9%(13)	d.	$15,000 - $19,999
6.1%(5)	e.	$20,000 - $24,999
11.6%(9)	f.	$25,000 - $29,999
14.6%(12)	g.	$30,000 - $34,999
8.5%(7)	h.	$35,000 - $39,999
12.2%(10)	i.	$40,000 - $44,999
4.9%(4)	j.	$45,000 - $49,999
3.7%(3)	k.	$50,000 - $54,999
1.2%(1)	l.	$55,000 - $59,999
8.5%(7)	m.	$60,000 and Over Treated as $62,500
	n.	Refused
	o.	Not Sure

Mean=$31,707 Standard error of mean $1,749

Thank you. We appreciate your cooperation.

☐ comments

71

ADULTS

ASTHMA BEHAVIOR AND EXPENDITURE STUDY

RESPONDENT NOTEBOOK

QUESTION 3

THINGS YOU MIGHT BUY OR USE OR DO TO MAKE YOUR OR YOUR HOUSEHOLD'S ASTHMA LESS OF A PROBLEM:

MEDICATIONS FOR ASTHMA

AIR PURIFIER

INTERMITTENT POSITIVE PRESSURE BREATHING MACHINE (IPPB)

HAND HELD NEBULIZATION MACHINE

MASKS

OXYGEN

SPECIAL TREATMENT PROGRAMS (SPECIFY)

RELANDSCAPING THE YARD

OTHER (SPECIFY)

OTHER (SPECIFY)

OTHER (SPECIFY)

OTHER (SPECIFY)

PLEASE WAIT FOR INSTRUCTIONS BEFORE CONTINUING

QUESTION 7

WHICH OF THE FOLLOWING DESCRIBE YOUR PRESENT EMPLOYMENT STATUS?

A. EMPLOYED FULL-TIME

B. EMPLOYED PART-TIME

C. HOMEMAKER

D. RETIRED

E. RETIRED DUE TO HEALTH PROBLEMS

F. STUDENT

G. NOT PRESENTLY EMPLOYED, BUT LOOKING FOR EMPLOYMENT

H. OTHER (SPECIFY)

PLEASE WAIT FOR INSTRUCTIONS BEFORE CONTINUING

QUESTION 8

PLEASE INDICATE THE ANSWERS THAT DESCRIBE HOW YOUR ASTHMA AFFECTS YOUR CURRENT EMPLOYMENT STATUS.

A. MY ASTHMA IS NOT IMPORTANT OR IS OF MINOR IMPORTANCE TO MY CURRENT EMPLOYMENT STATUS.

B. BECAUSE OF MY ASTHMA, I AM A HOMEMAKER, A STUDENT, RETIRED, OR UNEMPLOYED.

C. BECAUSE OF MY ASTHMA, I DO NOT WORK AT ALL DURING PART OF THE YEAR (PLEASE INDICATE WHICH SEASONS)

D. BECAUSE OF MY ASTHMA, I WORK ONLY PART-TIME YEAR ROUND

E. BECAUSE OF MY ASTHMA, I WORK ONLY PART-TIME DURING PART OF THE YEAR (PLEASE INDICATE WHICH SEASONS)

F. OTHER, PLEASE EXPLAIN.

PLEASE WAIT FOR INSTRUCTIONS BEFORE CONTINUING

QUESTION 13A

PLEASE THINK ABOUT A SITUATION WHERE YOU ARE OFFERED A JOB SIMILAR TO WHAT YOU NOW HAVE, BUT YOU COULD EXPECT TO HAVE BAD ASTHMA DAYS ABOUT HALF AS OFTEN AS YOU DO NOW.

WHAT WOULD BE THE BIGGEST PAY CUT YOU WOULD ACCEPT AND STILL TAKE THE NEW JOB? THE LIST OF DOLLAR AMOUNTS IS ONLY TO HELP YOU. PLEASE FEEL FREE TO SELECT A LISTED AMOUNT OR GIVE ANY OTHER AMOUNT.

HOURLY PAY CUT		PAY CUT PER 40 HOUR WEEK		PAY CUT PER FULL TIME YEAR
$ 0.00	=	$ 0.00	=	$ 0.00
.10	=	4.00	=	200.00
.20	=	8.00	=	400.00
.30	=	12.00	=	600.00
.40	=	16.00	=	800.00
.50	=	20.00	=	1000.00
.75	=	30.00	=	1500.00
1.00	=	40.00	=	2000.00
1.25	=	50.00		2500.00
1.50	=	60.00	=	3000.00
1.75	=	70.00	=	3500.00
2.00	=	80.00	=	4000.00
3.00	=	120.00	=	6000.00
4.00	=	160.00	=	8000.00
5.00	=	200.00	=	10,000.00
6.00	=	240.00	=	12,000.00
7.00	=	280.00	=	14,000.00
8.00	=	320.00	=	16,000.00
9.00	=	360.00	=	18,000.00
10.00	=	400.00	=	20,000.00

IF GREATER THAN $10.00/HOUR PLEASE GIVE THE AMOUNT.

PLEASE WAIT FOR INSTRUCTIONS BEFORE CONTINUING

QUESTION 13B

WHICH OF THE FOLLOWING REASONS BEST EXPLAIN YOUR ANSWER TO THE PREVIOUS QUESTION #13A?

A. HAVING BAD ASTHMA DAYS HALF AS OFTEN WOULD NOT BE WORTH ANY PAY CUT.

B. I COULDN'T GET BY WITH LESS PAY THAN I NOW RECEIVE.

C. I DON'T BELIEVE THAT A JOB CHANGE COULD REDUCE MY ASTHMA THAT MUCH.

D. I WOULD NOT WANT TO GIVE UP THE OTHER BENEFITS OF MY CURRENT JOB.

E. OTHER (PLEASE SPECIFY)

PLEASE WAIT FOR INSTRUCTIONS BEFORE CONTINUING

QUESTION 15A

Please think about a situation where you are offered a job similar to what you now have, but you could expect to have Bad Asthma Days about twice as often as you do now.

What would be the smallest pay increase you would require to take the new job? The list of dollar amounts is only to help you. Please feel free to select a listed amount or give any other amount.

Hourly Pay Increase		Pay Increase per 40 Hour Week		Pay Increase pe Full Time Year
$ 0.00	=	$ 0.00	=	$ 0.00
.10	=	4.00	=	200.00
.20	=	8.00	=	400.00
.30	=	12.00	=	600.00
.40	=	16.00	=	800.00
.50	=	20.00	=	1000.00
.75	=	30.00	=	1500.00
1.00	=	40.00	=	2000.00
1.25	=	50.00		2500.00
1.50	=	60.00	=	3000.00
1.75	=	70.00	=	3500.00
2.00	=	80.00	=	4000.00
3.00	=	120.00	=	6000.00
4.00	=	160.00	=	8000.00
5.00	=	200.00	=	10,000.00
6.00	=	240.00	=	12,000.00
7.00	=	280.00	=	14,000.00
8.00	=	320.00	=	16,000.00
9.00	=	360.00	=	18,000.00
10.00	=	400.00	=	20,000.00

If greater than $10.00/hour please give the amount.

PLEASE WAIT FOR INSTRUCTIONS BEFORE CONTINUING

QUESTION 15B

WHICH OF THE FOLLOWING REASONS BEST EXPLAINS YOUR ANSWER TO THE PREVIOUS QUESTION #15A?

A. NO PAY INCREASE WOULD MAKE ME WILLING TO HAVE BAD ASTHMA DAYS TWICE AS OFTEN.

B. I DON'T BELIEVE THAT A JOB CHANGE COULD INCREASE MY ASTHMA THAT MUCH.

C. I WOULD NOT WANT TO GIVE UP THE OTHER BENEFITS OF MY CURRENT JOB.

D. OTHER (PLEASE SPECIFY)

PLEASE WAIT FOR INSTRUCTIONS BEFORE CONTINUING

QUESTION 18

PLEASE THINK ONLY ABOUT THOSE CHORES THAT YOU USUALLY DO THAT NEED TO BE DONE MOST EVERY DAY. WHEN YOU HAVE A BAD ASTHMA DAY, OR A PERIOD OF TIME WITH FREQUENT BAD ASTHMA DAYS, HOW DO THESE CHORES THAT YOU USUALLY DO GET DONE? PLEASE PICK THE BEST ANSWERS.

A. I USUALLY STILL DO THEM, BUT THEY ARE LESS ENJOYABLE.

B. I USUALLY STILL DO THEM, BUT IT TAKES LONGER.

C. I USUALLY STILL DO THEM, BUT AT A DIFFERENT TIME OF DAY.

D. I USUALLY HAVE SOMEONE ELSE IN THE HOUSEHOLD DO THEM.

E. THEY USUALLY JUST DON'T GET DONE THAT DAY.

F. USUALLY SOMEONE OUTSIDE OF THE HOUSEHOLD DOES THEM (SUCH AS GOING OUT TO EAT, HIRING A HOUSECLEANER, ETC.)

G. OTHER - PLEASE EXPLAIN.

PLEASE WAIT FOR INSTRUCTIONS BEFORE CONTINUING

QUESTION 21

WHEN YOU ARE HAVING A BAD ASTHMA DAY THAT AFFECTS YOUR LEISURE ACTIVITIES, WHICH OF THE FOLLOWING DESCRIBE HOW YOUR LEISURE ACTIVITIES ARE AFFECTED? PLEASE PICK ALL THAT APPLY.

A. I USUALLY CHANGE THE TYPES OF ACTIVITIES I DO.

B. I USUALLY DO THE SAME ACTIVITIES, BUT AT A DIFFERENT TIME OF THE DAY.

C. I USUALLY SPEND LESS TIME ON LEISURE ACTIVITIES.

PLEASE WAIT FOR INSTRUCTIONS BEFORE CONTINUING

QUESTION 26

BY MOVING, WHAT THINGS THAT WORSEN YOUR (OR YOUR HOUSEHOLD'S) ASTHMA WOULD YOU BE AVOIDING?

A. STRESS, TENSION, ANXIETY

B. AIR POLLUTION

C. POLLENS, PLANTS AND ANIMALS

D. WEATHER IN THIS AREA

E. OTHER - PLEASE EXPLAIN

PLEASE WAIT FOR INSTRUCTIONS BEFORE CONTINUING

QUESTIONS 27 AND 28

WHICH OF THE FOLLOWING REASONS EXPLAIN WHY YOU WOULD NOT MOVE?

A. FAMILY AND FRIENDS HERE

B. JOB HERE

C. THE CHANGE IN ASTHMA WOULD NOT BE IMPORTANT ENOUGH

D. THE MOVING COSTS WOULD BE TOO HIGH

E. I DON'T BELIEVE THERE IS ANY PLACE IN THE LOS ANGELES AREA WHERE MY ASTHMA COULD BE THAT MUCH BETTER.

F. OTHER (PLEASE SPECIFY)

PLEASE WAIT FOR INSTRUCTIONS BEFORE CONTINUING

QUESTION 29

HERE ARE SOME POSSIBLE BENEFITS YOU MIGHT RECEIVE FROM HAVING YOUR ASTHMA IMPROVE. PLEASE TAKE YOUR TIME AND RANK THEM FROM MOST IMPORTANT TO LEAST IMPORTANT. EXCLUDE ANY THAT ARE OF NO IMPORTANCE.

A. LOWER EXPENDITURES ON DOCTORS, HOSPITALS, MEDICINES, SPECIAL EQUIPMENT AND SERVICES.

B. HIGHER PRODUCTIVITY AT WORK OR ABILITY TO GET HIGHER WAGES AND SALARIES.

C. MORE FLEXIBILITY ABOUT WHERE TO LIVE.

D. BETTER CHANCE TO PARTICIPATE IN DESIRED LEISURE, RECREATION AND SOCIAL ACTIVITIES.

E. LESS PAIN AND SUFFERING.

PLEASE WAIT FOR INSTRUCTIONS BEFORE CONTINUING

QUESTION 30A

IF FEDERAL, STATE OR LOCAL GOVERNMENTS SET UP PROGRAMS THAT COULD REDUCE POLLENS, DUSTS, AIR POLLUTANTS, AND OTHER FACTORS THROUGHOUT THIS AREA THAT MIGHT REDUCE YOUR (AND YOUR HOUSEHOLD'S) BAD ASTHMA DAYS BY HALF, BUT WOULD COST YOU INCREASED TAX DOLLARS, WHAT WOULD BE THE MAXIMUM INCREASE IN TAXES EACH YEAR THAT YOU AND YOUR HOUSEHOLD WOULD BE WILLING TO PAY AND STILL SUPPORT SUCH A PROGRAM? THE LIST OF DOLLAR AMOUNTS IS ONLY TO HELP YOU. PLEASE FEEL FREE TO SELECT A LISTED AMOUNT OR GIVE ANY OTHER AMOUNT.

$0
$10
$20
$30
$40
$50

$75
$100
$125
$150
$175
$200

$300
$400
$500
$600
$700
$800
$900
$1000

$2000
$3000
$4000
$5000
$6000
$7000
$8000
$9000
$10,000

PLEASE WAIT FOR INSTRUCTIONS BEFORE CONTINUING

QUESTION 30B

WHICH OF THE FOLLOWING REASONS BEST EXPLAINS YOUR ANSWER TO THE PREVIOUS QUESTION #30A?

A. HAVING BAD ASTHMA DAYS HALF AS OFTEN WOULD NOT BE WORTH ANY INCREASE IN TAXES.

B. OUR TAXES ARE ALREADY TOO HIGH.

C. I DON'T BELIEVE ANY SUCH PROGRAM COULD REDUCE MY BAD ASTHMA DAYS BY HALF.

D. I SHOULD NOT HAVE TO PAY FOR SUCH PROGRAMS; THEY SHOULD BE UNDERTAKEN BY GOVERNMENT AND INDUSTRY WITHOUT ANY INCREASE IN TAXES.

E. OTHER (PLEASE SPECIFY)

PLEASE WAIT FOR INSTRUCTIONS BEFORE CONTINUING

QUESTION 31

PLEASE GIVE THE CODE LETTER OF THE CATEGORY THAT BEST DESCRIBES THE COMBINED BEFORE-TAXES INCOME THAT YOU AND ALL OTHER MEMBERS OF YOUR HOUSEHOLD EXPECT TO RECEIVE IN 1983.

A. UNDER $5,000
B. $ 5,000 - $ 9,999
C. $10,000 - $14,999
D. $15,000 - $19,999
E. $20,000 - $24,999
F. $25,000 - $29,999
G. $30,000 - $34,999
H. $35,000 - $39,999
I. $40,000 - $44,999
J. $45,000 - $49,999
K. $50,000 - $54,999
L. $55,000 - $59,999
M. $60,000 AND OVER

THANK YOU. WE APPRECIATE YOUR COOPERATION.

ASTHMATIC BEHAVIOR AND EXPENDITURES STUDY
GENERAL QUESTIONNAIRE
To Be Completed by Parent or Guardian of
Panelists Less than 16 Years of Age

[2]
1

[ ][ ][ ] ID#
2 3 4

[1] CARD #
5

[ ] INTERVIEWER #
6

These questions have to do with how your child's asthma affects your health expenditures, his/her schoolwork, his/her leisure, and where you live. Some questions are similar to those in earlier UCLA questionnaires. This is done so that we will have the most up-to-date information.

Your responses will help improve the scientific understanding of how asthma affects a person's well-being. Your careful consideration of each question is appreciated. All your answers are voluntary and will be confidential. Please do not hesitate to ask me to repeat any question.

Here is a booklet to help you answer some of the questions. Please do not turn to the first page until you receive instructions to do so. (HAND NOTEBOOK) Not all questions are in the booklet and you will be skipping some of the questions in the booklet, so please wait for instructions before continuing in the booklet.

Some of these questions refer to Bad Asthma Days. You are the judge of what is a Bad Asthma Day for your child. To help us understand what you consider to be a Bad Asthma Day for your child, please answer the question on the first page of the notebook.

Using the UCLA scale, please select the highest overall daytime asthma rating that you would still consider to be a GOOD ASTHMA DAY for your child.

BAD ASTHMA DAYS would be days with an overall asthma rating above this. (Divide Scale into GOOD ASTHMA DAYS and BAD ASTHMA DAYS.)

1	2	3	4	5	6	7
None	Very Mild	Mild	Moderate	Moderately Severe	Severe	Very Severe

[ ] highest good day
7

(THROUGHOUT PLEASE REPLACE "your child's" BY PANELIST'S FIRST NAME)

PART I. OTHER ASTHMATICS IN THE HOUSEHOLD

QUESTION 1. a. How many people live in your household? ______

[ ][ ]
8 9

b. Besides ______________ (NAME OF CHILD), are there other asthmatics in your household?

[ ]
10

__________ NO. (0)(SKIP TO PART II)
__________ YES. (1)(CONTINUE)

QUESTION 2. ☐ 11

a. Please rate your child's asthma as either mild (1), moderate (2), or severe (3)
_________ (Rating)

b. Please give the relationships of other asthmatics in the household and rate their asthma as either mild, moderate, or severe.

☐☐ 12 13

	Relationships	MILD (1)	MODERATE (2)	SEVERE (3)
1	________	______	______	______
2	________	______	______	______
3	________	______	______	______
4	________	______	______	______

PART II. EXPENDITURES

QUESTION 3. As a result of asthma, what types of medical supplies, household supplies, equipment and special treatment programs do you and members of your household buy or use, that you would not have purchased or would not use if your child (and other members of your household) did not have asthma? To help you, please look at the list of items on the page titled Question 3.

a. Have you purchased or do you rent ________________ that you would not otherwise have if no one in your household had asthma? (IF NOT USED, CHECK COLUMN 1)

b. Is this a one-time purchase or something you purchase or rent from time to time? (CHECK EITHER COLUMN 2 OR COLUMN 3.)

(CONTINUE THROUGH LIST AND ASK FOR OTHER ITEMS THAT HAVE NOT BEEN LISTED, EVEN IF INFREQUENTLY USED.)

QUESTION 4. a. Please estimate the one-time purchase price or costs per year of buying or renting each item. (COLUMN 4)

b. Is this mostly paid by your household or by a medical payment plan (such as health insurance, MEDICAL, HMO, etc.)? (WRITE 'YES' OR 'NO' IN COLUMN 5.)

V2-3

Column	(1)	(2)	(3)	(4)	(5)
	CHECK IF				
Item	Not Used	One time Purchase	Periodic Purchase or Rental	Cost to Buy or Annual Cost	Household Pays Most (Yes/No)
Medications for Asthma*					
Air Purifier					
Intermittent Positive Pressure Breathing Machine (IPPB)					
Hand Held Nebulization Machine					
Masks					
Oxygen					
Special Treatment Programs (SPECIFY) ________					
Relandscaping the Yard					
Other (SPECIFY) ________					
Other (SPECIFY) ________					
Other (SPECIFY) ________					
Other (SPECIFY) ________					
Other (SPECIFY) ________					

*Includes bronchodilators, inhalers, tablets, steroids, etc.

☐	☐	☐	☐	☐
14	15	16	17	18

☐	☐	☐	☐	☐
19	20	21	22	23

QUESTION 5. a. In the last year, has your child been admitted to the hospital for his/her asthma?

☐ 24

________ NO. (0) **(SKIP TO QUESTION 5b)**
________ YES. (1) (CONTINUE)
On his/her last visit, how many days did he/she stay?
____

☐☐☐☐☐ 25 26 27 28 29

On his/her last visit, what type of treatment did he/she have? ________

b. In the last year, has your child visited the hospital emergency room for his/her asthma?

☐ 30

________ NO. (0) **(SKIP TO QUESTION 5c)**
________ YES. (1) (CONTINUE)
On his/her last visit, what type of treatment did he/she have?

☐☐☐☐ 31 32 33 34

____

c. In the last year, has your child visited the doctor's office because of his/her asthma?

☐ 35

________ NO. (0) **(SKIP TO QUESTION 6)**
________ YES. (1) (CONTINUE)
On his/her last visit to the doctor's office what type of treatment did he/she have?

☐☐☐☐ 36 37 38 39

________ Regular check-up
________ Other (SPECIFY) ________

QUESTION 6. Do you have a medical payment program (such as health insurance, MEDICAL, HMO, etc.) that covers any of your child's doctor and hospital expenses related to asthma?

________ NO. Is his/her asthma part of the reason why you do not have such insurance?
________ NO. (0) **(SKIP TO PART III)**
________ YES. (1) (EXPLANATION IF OFFERED)
____

☐ 40

________ YES. (2)

41-56 skipped

PART III. SCHOOL

(SKIP PART III IF CHILD IS A PRESCHOOLER)

This section asks about how your child's asthma affects him/her at school.

QUESTION 7. a. In the last year, has your child's asthma affected his/her performance at school?

☐ 57

________ NO. (0)
________ YES. (1) Do you believe this hurts your child's grades?
________ NO. (0)
________ YES. (1)

☐ 58

b. Does your child's asthma affect your child's participation in extracurricular activities?

☐ 59

________ NO. (0)
________ YES. (1)

60-80 skipped

☐☐☐ ID #
1 2 3
2 Card #
4

PART IV. LEISURE ACTIVITIES

This section asks how your child's asthma affects his/her leisure activities, that is the things he/she does in his/her free time that he/she does not consider to be chores or schoolwork.

QUESTION 8. In the last year, has your child's asthma affected his/her leisure activities?

5-18 skipped

☐ 19

________ NO (0) (SKIP TO SECTION VI)
________ YES (1) (CONTINUE)

QUESTION 9. Please turn to the page titled Question 9. When your child is having a Bad Asthma Day that affects his/her leisure activities, which of the following describe how your child's leisure activities are affected? Please pick all that apply.

20-22 skipped

If checked enter 1 in column →
23 ________ a. He/she usually changes the types of activities he/she does.
24 ________ b. He/she usually does the same activities, but at a different time of the day.
25 ________ c. He/she usually spends less time on leisure activities.

PART V. RESIDENTIAL LOCATION

QUESTION 10. How long has your household lived in the greater Los Angeles area?
☐☐ Years
26 27

QUESTION 11. How long has your household lived in the Glendora area?
☐☐ Years
28 29

QUESTION 12. Does your household own or rent your current residence?

☐ 30

☐☐ 31 32

________ Rent (0)
________ Own (1), For how many years? ______ years

QUESTION 13. Some people think their asthma is affected by where they live. Do you think living in different communities would have different affects on your child's asthma?

☐ 33

______ NO. (SKIP TO PART VI)
______ YES OR MAYBE. (INCLUDES SOME THINGS ARE BETTER; SOME THINGS ARE WORSE)

QUESTION 14. Have you and your household ever considered moving away from Glendora in order to reduce your child's exposure to those things that worsen his/her asthma?

☐ 34

35 skipped

________ NO. (SKIP TO QUESTION 15)
________ YES. (IF YES, ASK) Please turn to the page titled Question 14. By moving, what things that worsen your child's (or your household's) asthma would you be avoiding?

If checked enter 1 in column →
36 ________ a. Air pollution
37 ________ b. Pollens, plants and animals
38 ________ c. Weather in this area
39 ________ d. Other (SPECIFY) ____________________

QUESTION 15. a. Would you move to another community in the greater Los Angeles area if you thought your child would have about half as many Bad Asthma Days* as he/she now has?

☐ 40

________ YES. (1) **(SKIP TO PART VI)**
________ NO. (0) (CONTINUE)

b. Please turn to the page titled Questions 15 and 16. Which of the following reasons explain why you would not move? (MULTIPLE ANSWERS ALLOWABLE)

If checked enter 1 in column →

41 ________ a. Family and friends here.
42 ________ b. Job here
43 ________ c. The change in asthma would not be important enough
44 ________ d. The moving costs would be too high
45 ________ e. I don't believe there is any place in the Los Angeles area where my asthma could be that much better. **(IF CHECKED, SKIP TO PART VI)**
46 ________ f. Other (SPECIFY) ______________________

QUESTION 16. a. Would you move to another community in the greater Los Angeles area if you thought your child would have almost no Bad Asthma Days after moving?

☐ 48

________ YES. (1) **(SKIP TO PART VII)**
________ NO. (0) (CONTINUE)

b. Look again at the page titled Questions 15 and 16. Which of the following reasons explain why you would not move? (MULTIPLE ANSWERS ALLOWABLE)

If checked enter 1 in column →

49 ________ a. Family and friends here.
50 ________ b. Job here.
51 ________ c. The change in asthma would not be important enough.
52 ________ d. The moving costs would be too high.
53 ________ e. I don't believe that there is any place in the Los Angeles area where my child's asthma could be that much better.
54 ________ f. Other (SPECIFY) ______________________

PART VI. OTHER

QUESTION 17. Please turn to the page titled Question 17. Here are some possible benefits your child and your household might receive from having your child's asthma improve. Please take your time and rank them from most important to least important. Exclude any that are of no importance.

		RANKING		CATEGORIES
☐ 55	Most important	________	a.	Lower expenditure on doctors, hospitals, medicines, special equipment and services.
☐ 56		________	b.	Less interference with his/her schoolwork
☐ 57		________	c.	More flexibility about where to live.
☐ 58		________	d.	Better chance to participate in desired leisure, recreation and social activities.
☐ 59	Least important	________	e.	Less pain and suffering.

---

47 ☐ *IF REQUESTED ADD: This question is hypothetical but for some people this could occur through less exposure to air pollution, pollens, and plants; or a difference in weather.

QUESTION 18. a. Please turn to the page titled Question 18a. If federal, state, or local governments set up programs that could reduce pollens, dusts, air pollutants and other factors throughout this area that might reduce your child's (and your household's) Bad Asthma Days by half but would cost you increased tax dollars, what would be the maximum increase in taxes each year that you and your household would be willing to pay and still support such a program? The list of dollar amounts is only to help you. Please feel free to select a listed amount or give any other amount.

☐☐☐☐☐
60 61 62 63 64

_______ $/Year.

(ASK 18b IF RESPONSE TO 18a WAS $0.0 OR RESPONDENT REFUSED TO CHOOSE ANY DOLLAR AMOUNT, OTHERWISE SKIP TO QUESTION 19)

b. Please turn to the page titled Question 18b. Which of the following reasons best explains your answer to the previous question #18a?

☐
65

____ a. Having Bad Asthma Days half as often would not be worth any increase in taxes.

____ b. Our taxes are already too high.

____ c. I don't believe any such program could reduce my child's Bad Asthma Days by half.

____ d. I should not have to pay for such programs, they should be undertaken by government and industry without any increase in taxes.

____ e. Other (PLEASE SPECIFY) ______________________

QUESTION 19. Please turn to the page titled Question 19. Here is a list of income categories. Please give the code letter of the category that best describes the combined before taxes income that you and all other members of your household expect to receive in 1983. Please include wages, salaries, net income from businesses, pensions, dividends, interest, and other income.

☐☐☐☐☐
66 67 68 69 70

_______ a. Under $5,000
_______ b. $ 5,000 - $ 9,999
_______ c. $10,000 - $14,999
_______ d. $15,000 - $19,999
_______ e. $20,000 - $24,999
_______ f. $25,000 - $29,999
_______ g. $30,000 - $34,999
_______ h. $35,000 - $39,999
_______ i. $40,000 - $44,999
_______ j. $45,000 - $49,999
_______ k. $50,000 - $54,999
_______ l. $55,000 - $59,999
_______ m. $60,000 and Over
_______ n. Refused
_______ o. Not Sure

Thank you. We appreciate your cooperation.

☐ Comments
71

V2

PARENTS OF CHILDREN

ASTHMA BEHAVIOR AND EXPENDITURE STUDY

RESPONDENT NOTEBOOK

V2

USING THE UCLA SCALE, PLEASE SELECT THE HIGHEST OVERALL DAYTIME ASTHMA RATING THAT YOU WOULD STILL CONSIDER TO BE A GOOD ASTHMA DAY FOR YOUR CHILD.

BAD ASTHMA DAYS WOULD BE DAYS WITH AN OVERALL ASTHMA RATING ABOVE THIS. (DIVIDE SCALE INTO GOOD ASTHMA DAYS AND BAD ASTHMA DAYS.)

1	2	3	4	5	6	7
NONE	VERY MILD	MILD	MODERATE	MODERATELY SEVERE	SEVERE	VERY SEVERE

PLEASE WAIT FOR INSTRUCTIONS BEFORE CONTINUING

QUESTION 3

THINGS YOU MIGHT BUY OR USE OR DO TO MAKE YOUR CHILD'S OR YOUR HOUSEHOLD'S ASTHMA LESS OF A PROBLEM:

MEDICATIONS FOR ASTHMA

AIR PURIFIER

INTERMITTENT POSITIVE PRESSURE BREATHING MACHINE (IPPB)

HAND HELD NEBULIZATION MACHINE

MASKS

OXYGEN

SPECIAL TREATMENT PROGRAMS

RELANDSCAPING THE YARD

OTHER (SPECIFY)

OTHER (SPECIFY)

OTHER (SPECIFY)

OTHER (SPECIFY)

PLEASE WAIT FOR INSTRUCTIONS BEFORE CONTINUING

QUESTION 9

WHEN YOUR CHILD IS HAVING A BAD ASTHMA DAY THAT AFFECTS HIS/HER LEISURE ACTIVITIES, WHICH OF THE FOLLOWING DESCRIBE HOW HIS/HER LEISURE ACTIVITIES ARE AFFECTED? PLEASE PICK ALL THAT APPLY.

A. HE/SHE USUALLY CHANGES THE TYPES OF ACTIVITIES HE/SHE DOES.

B. HE/SHE USUALLY DOES THE SAME ACTIVITIES, BUT AT A DIFFERENT TIME OF THE DAY.

C. HE/SHE USUALLY SPENDS LESS TIME ON LEISURE ACTIVITIES.

PLEASE WAIT FOR INSTRUCTIONS BEFORE CONTINUING

QUESTION 14

BY MOVING, WHAT THINGS THAT WORSEN YOUR CHILD'S (OR YOUR HOUSEHOLD'S) ASTHMA WOULD YOU BE AVOIDING?

A. AIR POLLUTION

B. POLLENS, PLANTS AND ANIMALS

C. WEATHER IN THIS AREA

D. OTHER (PLEASE SPECIFY)

PLEASE WAIT FOR INSTRUCTIONS BEFORE CONTINUING

QUESTIONS 15 AND 16

WHICH OF THE FOLLOWING REASONS EXPLAIN WHY YOU WOULD NOT MOVE?

A. FAMILY AND FRIENDS HERE

B. JOB HERE

C. THE CHANGE IN ASTHMA WOULD NOT BE IMPORTANT ENOUGH

D. THE MOVING COSTS WOULD BE TOO HIGH

E. I DON'T BELIEVE THERE IS ANY PLACE IN THE LOS ANGELES AREA WHERE MY CHILD'S ASTHMA COULD BE THAT MUCH BETTER.

F. OTHER (PLEASE SPECIFY)

PLEASE WAIT FOR INSTRUCTIONS BEFORE CONTINUING

QUESTION 17

HERE ARE SOME POSSIBLE BENEFITS YOUR CHILD AND YOUR HOUSEHOLD MIGHT RECEIVE FROM HAVING YOUR CHILD'S ASTHMA IMPROVE. PLEASE TAKE YOUR TIME AND RANK THEM FROM MOST IMPORTANT TO LEAST IMPORTANT. EXCLUDE ANY THAT ARE OF NO IMPORTANCE.

A. LOWER EXPENDITURES ON DOCTORS, HOSPITALS, MEDICINES, SPECIAL EQUIPMENT AND SERVICES.

B. LESS INTERFERENCE WITH HIS/HER SCHOOLWORK

C. MORE FLEXIBILITY ABOUT WHERE TO LIVE.

D. BETTER CHANCE TO PARTICIPATE IN DESIRED LEISURE, RECREATION AND SOCIAL ACTIVITIES.

E. LESS PAIN AND SUFFERING.

PLEASE WAIT FOR INSTRUCTIONS BEFORE CONTINUING

QUESTION 18A

IF FEDERAL, STATE OR LOCAL GOVERNMENTS SET UP PROGRAMS TO REDUCE POLLENS, DUSTS, AIR POLLUTANTS, AND OTHER FACTORS THROUGHOUT THIS AREA THAT MIGHT REDUCE YOUR CHILD'S (AND YOUR HOUSEHOLD'S) BAD ASTHMA DAYS BY HALF, BUT WOULD COST YOU INCREASED TAX DOLLARS, WHAT WOULD BE THE MAXIMUM INCREASE IN TAXES EACH YEAR THAT YOU AND YOUR HOUSEHOLD WOULD BE WILLING TO PAY AND STILL SUPPORT SUCH A PROGRAM? THE LIST OF DOLLAR AMOUNTS IS ONLY TO HELP YOU. PLEASE FEEL FREE TO SELECT A LISTED AMOUNT OR GIVE ANY OTHER AMOUNT.

$0
$10
$20
$30
$40
$50
$75
$100
$125
$150
$175
$200
$300
$400
$500
$600
$700
$800
$900
$1000
$2000
$3000
$4000
$5000
$6000
$7000
$8000
$9000
$10,000

PLEASE WAIT FOR INSTRUCTIONS BEFORE CONTINUING

QUESTION 18B

WHICH OF THE FOLLOWING REASONS BEST EXPLAINS YOUR ANSWER TO THE PREVIOUS QUESTION #18A?

A. HAVING BAD ASTHMA DAYS HALF AS OFTEN WOULD NOT BE WORTH ANY INCREASE IN TAXES

B. OUR TAXES ARE ALREADY TOO HIGH

C. I DON'T BELIEVE ANY SUCH PROGRAM COULD REDUCE MY CHILD'S BAD ASTHMA DAYS BY HALF

D. I SHOULD NOT HAVE TO PAY FOR SUCH PROGRAMS, THEY SHOULD BE UNDERTAKEN BY GOVERNMENT AND INDUSTRY WITHOUT ANY INCREASE IN TAXES

E. OTHER (PLEASE SPECIFY)

PLEASE WAIT FOR INSTRUCTIONS BEFORE CONTINUING

QUESTION 19

PLEASE GIVE THE CODE LETTER OF THE CATEGORY THAT BEST DESCRIBES THE COMBINED BEFORE-TAXES INCOME THAT YOU AND ALL OTHER MEMBERS OF YOUR HOUSEHOLD EXPECT TO RECEIVE IN 1983.

A. UNDER $5,000
B. $ 5,000 - $ 9,999
C. $10,000 - $14,999
D. $15,000 - $19,999
E. $20,000 - $24,999
F. $25,000 - $29,999
G. $30,000 - $34,999
H. $35,000 - $39,999
I. $40,000 - $44,999
J. $45,000 - $49,999
K. $50,000 - $54,999
L. $55,000 - $59,999
M. $60,000 AND OVER

THANK YOU. WE APPRECIATE YOUR COOPERATION.